

**Fish and Wildlife Coordination Act Report
For the
El Paso-Las Cruces Regional Sustainable Water Project
Dona Ana and Sierra County, New Mexico
El Paso County, Texas**



U.S. Fish and Wildlife Service

March 2001

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El Paso County, Texas

Submitted to:

International Boundary and Water Commission
El Paso, Texas

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INTRODUCTION

This is the Final Fish and Wildlife Coordination Act Report (CAR) for the El Paso-Las Cruces Regional Sustainable Water Project (Project) and has been prepared by the U.S. Fish and Wildlife Service (Service) under the authority of and in accordance with the requirements of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 USC 661-667e). This report has been prepared with the cooperation of the U.S. International Boundary and Water Commission (USIBWC) and the New Mexico Department of Game and Fish (NMDGF). Comments from both agencies have been incorporated into this report. Should project plans change or a considerable amount of time elapse before this project begins, impacts on fish and wildlife should be re-examined.

The New Mexico-Texas Water Commission (Commission) is implementing a regional water plan (the El Paso-Las Cruces Regional Sustainable Water Project) for southern New Mexico and western Texas. The Commission, which was formed in 1991 as part of a litigation settlement between El Paso and several New Mexico entities, includes seven-members: New Mexico State University (NMSU), Elephant Butte Irrigation District (EBID), Doña Ana County, City of Las Cruces, El Paso Water Utilities-Public Service Board (EPWU-PSB), El Paso County Water Improvement District No. 1 (EPCWID No. 1), and University of Texas at El Paso (UTEP). In November 2000, EPCWID No. 1 was removed from the Commission per their request and were replaced by the Texas A&M Research Station. Local aquifers (i.e., the Mesilla and Hueco Bolsons) are the major source of drinking water in the region, and some of these ground water supplies (e.g., the Texas portion of the Hueco Bolson) may be exhausted by the year 2025. To avoid potentially permanent impacts on the Mesilla and Hueco Bolsons, additional surface waters are needed to supplement the drinking water supply. The proposed project would provide an additional 174.5 million gallons per day (mgd) (660.5 million liters per day [mld]; 270.5 cubic feet per second [cfs]; 7.7 cubic meters per second [cms]) of surface water year-round to communities and other water users in the region. The project area extends approximately 200 miles (mi) (362 kilometers [km]) along the Rio Grande from Elephant Butte Reservoir, Sierra County, New Mexico, to Fort Quitman, Hudspeth County, Texas (Figure 1). The primary objective of the proposed project is to determine how to use the waters of the Rio Grande to ensure a high quality, sustainable water supply for Sierra and Doña Ana Counties, New Mexico, and El Paso County, Texas.

The City of El Paso is the third fastest growing metropolitan area in the nation with nearly 700,000 residents. Immediately across the Rio Grande from El Paso is Ciudad Juarez, Chihuahua, Mexico, where more than 1.5 million people reside (Draft Environmental Impact Statement [DEIS] 2000). The region's rapid growth and increasing demand on groundwater supplies has resulted in an imminent water supply shortage. By comparison, future water supply shortages in the Las Cruces, New Mexico, area are expected to be less severe, although continued rapid growth will result in increased municipal and industrial water needs in southern New Mexico as well (DEIS 2000).

This report describes fish and wildlife resources existing without the project, potential project impacts to fish and wildlife resources, a discussion of the potential benefits and concerns related to fish and wildlife resources, and recommendations (mitigation) to decrease adverse effects and provide benefits to fish and wildlife resources.

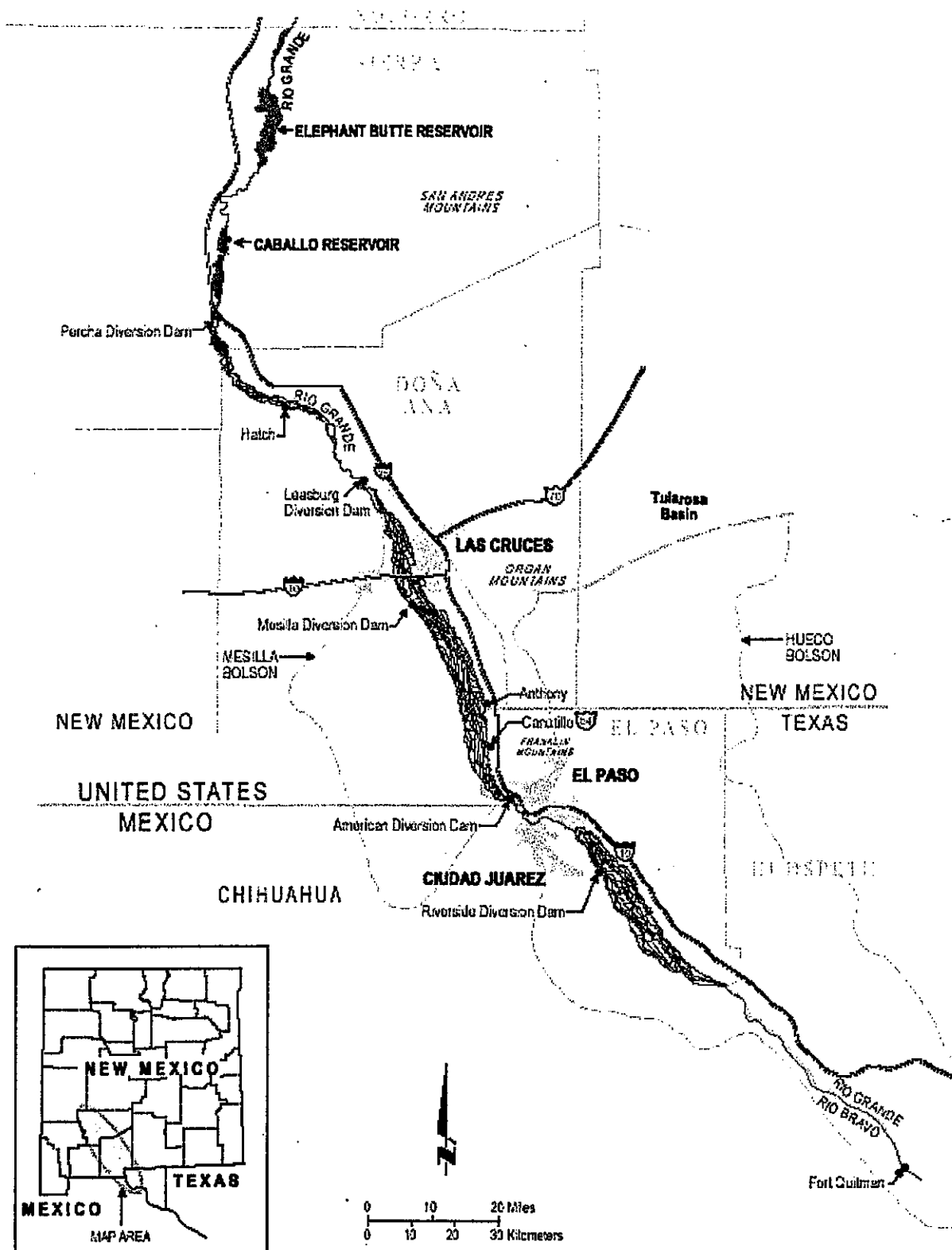


Figure 1. Map of Project area (modified from CH2M HILL and Geo-Marine, Inc. 2000).

STUDY AREA DESCRIPTION

The Rio Grande flows from its headwaters in southern Colorado, through New Mexico, depositing into the Gulf of Mexico as it forms the border between Texas and Mexico. The primary source of surface water for the 1,885 mi (3,035 km) of river begins in the mountains of Colorado. From a water resources perspective, the area of influence for the project begins at Elephant Butte Reservoir, New Mexico, and extends south approximately 200 mi (362 km) along the Rio Grande to Fort Quitman, Texas. The drainage basin above Elephant Butte Reservoir is 25,923 mi² (67,195 km²) and has a 79-year runoff average of 904,900 acre-feet (ac-ft) (1.1 billion cubic meters [m³]) (DEIS 2000). There are no major tributaries in the project area.

Project water storage is provided primarily in Elephant Butte Reservoir. Caballo Reservoir is used for flood control and seasonal water storage (DEIS 2000). The maximum combined storage for the two reservoirs is 2,396,520 ac-ft (2.96 billion m³). The normal annual release from the reservoirs, including Mexico's 60,000 ac-ft (7.4 million m³) allotment, totals 790,000 ac-ft (9.7 million m³) (U.S. Bureau of Reclamation [USBR] 1982).

The regulated flows in the Rio Grande downstream of Elephant Butte Reservoir follow a pattern of "high" flows during spring and summer and low flows during fall and winter months, with additional high flows from summer thunderstorms. An average annual hydrograph (USGS Gage at Station 08362500) for the river below Caballo Dam shows that the seasonal peak releases usually occur in June and July. Average monthly discharges range from approximately 48 to 1,895 cfs (1 to 54 cms). The average winter base flow of approximately 107 cfs (3 cms) usually persists from November through February and average flows during the primary irrigation season (March through October) are typically 1,318 cfs (37 cms) (DEIS 2000).

Historically, the Rio Grande in southern New Mexico was characterized by a wide, active floodplain with numerous marshes, backwaters, oxbow pools, and a fringe forest of cottonwoods, willows, and shrubby phreatophytes. Stream flows, although subject to great fluctuations, were believed to be perennial in all years. By 1880, most of the land along the river that could be irrigated was under development. Stream flows became more erratic and, in the Mesilla Valley, ceased completely at times. These conditions eventually led to the development of several major water projects on the river.

At the beginning of the 20th Century, the U.S. and Mexico began constructing dams and channelizing the Rio Grande to control sediment, drainage, and flooding, and to provide a more secure and stable water supply primarily for agricultural use. Elephant Butte Dam was completed and began operation in 1916, slowing the periodic flooding of the river. In 1933, plans were approved to straighten, stabilize, and shorten the Rio Grande east of El Paso, and to construct Caballo Dam, which was completed in 1938. From 1938 to 1943, the channel

between Caballo Dam and El Paso was straightened and a system of levees were constructed (Metz 1999). In the late 1950s the reach between Elephant Butte Dam and Caballo Reservoir was also channelized and annual channel maintenance (i.e., removal of islands, bars, arroyo plugs, and snags) still occurs (USBR 1975).

There are five mainstem diversions (Percha, Leasburg, Mesilla, American, and Riverside), and more than 1,000 mi (1,610 km) of canals, laterals, and drains in the project area downstream of Caballo Dam (USBR 1995). The channel and floodway have a capacity ranging from 22,000 cfs (623 cms) in the upper reaches to 17,000 cfs (481 cms) in the lower reaches. Within the United States section, the International Boundary and Water Commission operates and maintains the channel and floodway. Maintenance includes dredging sand out of the channel and mowing the floodway to limit the growth of riparian vegetation to maintain floodwater conveyance.

The environmental consequences of channelization activities include the severance of the river from its floodplain; the straightening, narrowing, and incising of the river channel; the curtailment of the meandering process that formed oxbows and backwaters, and the loss of native wetland and riparian vegetation. The incised channel and dam operations prevent overbank flows and periodic scouring of floodplain areas. Most of the floodplain of the Rio Grande has been replaced by row crops and orchards. Except for a few locations upstream of Selden Canyon, the river is now confined to a single channel that ranges in width from about 150 to 300 ft (46 to 91 m). A few gravel riffles occur upstream of Hatch, New Mexico, near the mouth of arroyos, and immediately downstream of Leasburg Dam that provide unique habitat for longnose dace. Aside from these areas, the streambed consists almost entirely of sand, which actively shifts and moves downstream even at moderate flows. The changed hydrology and current management practices largely preclude natural regeneration of native cottonwoods and willows and promotes the growth of non-native vegetation such as salt cedar and Russian olive, which have largely replaced the native cottonwood/willow vegetative complex. Cumulatively, all of these changes have significantly reduced the complexity of aquatic habitat and its ability to support a healthy fish community.

PROJECT DESCRIPTION

Five action alternatives and a No Action Alternative have been developed for the El Paso–Las Cruces Regional Sustainable Water Project:

- River Conveyance with Local Water Treatment Plants (WTPs) Alternative (Preferred Alternative)
- River Conveyance with Year-Round with Lower WTPs Alternative
- River Conveyance with Combined WTPs Alternative
- Aqueduct Conveyance with Local WTPs Alternative
- Aqueduct Conveyance with Combined WTPs Alternative

Brief descriptions of the Preferred Alternative, four other action alternatives, and the No Action Alternative are described below. Proposed project features include WTPs and associated facilities; aquifer storage and recovery; aqueducts and diversion structures; water acquisition through water rights purchases, water banking, and water conservation; river flows; and standard construction and operating requirements (CH2M HILL and Geo-Marine, Inc. 2000). The project would be implemented in 3 phases through the year 2030: Phase No. 1 from the present to 2010; Phase No. 2 from 2011 to 2020; and Phase No. 3 from 2021 to 2030. Detailed descriptions of each of the alternatives, associated project features, and supporting data are presented in Chapter 2 of the DEIS. Features planned for Phase 1 are based on feasibility-level design and are sufficiently well defined for this environmental analysis. Features to be built in Phases 2 and 3 are defined only at the conceptual level.

The USIBWC, the Federal lead agency, and the EPWU-PSB, the joint lead agency, have identified the River Conveyance with Local WTPs Alternative as the Preferred Alternative for the proposed project.

Preferred Alternative–River Conveyance with Local WTPs

Four new WTPs would be constructed, and one existing WTP would be expanded. New WTPs would be located in Hatch, New Mexico, Las Cruces (Interstate-10 site), New Mexico, Anthony, New Mexico, and Vinton (Upper Valley), Texas. The existing Jonathan Rogers WTP in El Paso would be expanded and the Canal WTP would operate the same as at present.

The Preferred Alternative would require the construction of four new permanent diversion structures on the Rio Grande to divert water to proposed WTPs. The diversion structures include the Hatch, Las Cruces, Anthony, and Upper Valley Diversions. The new diversion structures would be designed to provide fish passage and minimize the potential for fish entrainment and impingement.

A 32-mi-long (51.5 km) aqueduct, the El Paso Aqueduct, would be constructed. This underground pipeline would convey treated water from the proposed Upper Valley WTP at Vinton to demand centers in northwest and northeast El Paso, and to the Aquifer Storage and Recovery (ASR) system in northeast El Paso.

Treated surface waters conveyed from the Upper Valley WTP by the El Paso Aqueduct would be stored in a ground-water aquifer in the Hueco Bolson during periods of excess supply. These waters would be recovered by pumping during periods of surface water shortage. Exact specifications for some of the ASR facilities would vary according to site-specific conditions and would be determined during final project design.

The project's water supply would be increased by acquiring water rights and through forbearance agreements, water conservation, and water banking. Acquiring water rights would occur through the purchase of property, and the subsequent retirement of agricultural lands. A portion of water rights would be acquired by leasing through forbearance agreements, from interested parties. Projects that reduce water loss in the agricultural distribution system would achieve water savings through supply conservation gains. Lastly, water would be obtained from a water bank set up using long-term agreements.

Two specific mitigation measures would be implemented with the Preferred Alternative:

1. **Monitor agricultural drains.** Field studies would be conducted to confirm the hydrologic model projection that drains would not dry up. If drains do dry up, mitigation measures would be proposed to compensate for impacts.
2. **Transplant sensitive plants.** Approximately 60 clumps of sand prickly pear (a species of concern) would be transplanted from the El Paso Aqueduct right-of-way to a nearby location to avoid impacts from pipeline construction. Monitoring and remedial action will ensure transplant survival.

A number of standard construction and operating requirements designed to avoid or reduce potential short- and long-term adverse impacts would be implemented during construction and operation of all project features described above. They include landscape preservation and impact avoidance; erosion and sediment control; development of Storm Water Pollution Prevention Plans; standards for construction in sensitive areas such as wetlands, riparian, and instream habitats; site restoration and revegetation; prevention of water, noise, and air pollution; and proper hazardous material storage, handling, and disposal (CH2M HILL and Geo-Marine, Inc. 2000; DEIS 2000).

Project feature development with the Preferred Alternative would affect the amount and timing of flows, and the riverine ecosystem in reaches of the Rio Grande from Elephant Butte Reservoir downstream to Fort Quitman. Average releases from Caballo Dam during the secondary irrigation season (November through February) would be approximately 210 cfs (5.9 cms) in Phase 1, 199 cfs (5.6 cms) in Phase 2, and 204 cfs (5.9 cms) in Phase 3, which is

21 to 27 percent higher than the releases under the No Action Alternative (161 to 167 cfs; 4.6 to 4.7 cms) and 86 to 96 percent higher than baseline (107 cfs; 3 cms). Average releases from Caballo Dam during the primary irrigation season (March through October) would be approximately 2 to 3 percent lower than the No Action Alternative and 12 to 13 percent lower than baseline.

River Conveyance with Year-Round Lower WTPs Alternative

The design, construction, and operation of the project features would be identical to the Preferred Alternative, except less water would be diverted from the Rio Grande for treatment at the Upper Valley WTP, and more water would be diverted from the river for treatment at the Jonathan Rogers and Canal WTPs during the secondary irrigation season. As a result, more water would remain in the Rio Grande between the diversion points for these WTPs during the secondary irrigation season. These differences are discussed below.

For all phases, anticipated operational levels at these three WTPs during the secondary irrigation season under this alternative are 40 mgd (1.8 cms) at the Upper Valley WTP, 60 mgd (2.6 cms) at the Jonathan Rogers WTP, and 20 mgd (0.9 cms) at the Canal WTP. During the primary irrigation season, anticipated operational levels are 60 mgd (2.6 cms) at the Upper Valley WTP, 60 mgd (2.4 cms) in Phase 1 and 80 mgd (3.5 cms) in Phases 2 and 3 at the Jonathan Rogers WTP, and 40 mgd (1.8 cms) at the Canal WTP.

The El Paso Aqueduct would convey 40 mgd (1.8 cms) of treated water during the secondary irrigation season and 60 mgd (2.6 cms) of treated water during the primary irrigation season to northeast and northwest El Paso in each project phase, as compared to 80 mgd (3.5 cms) at all times with the Preferred Alternative.

Mean releases from Caballo Dam in an average water year would be nearly two times higher than for the Preferred Alternative in all phases (e.g., Phase 3: 394 cfs versus 204 cfs; 11.1 cms versus 5.8 cms) during the secondary irrigation season. Flows during the primary irrigation season would be lower with this alternative than with the Preferred Alternative, particularly during Phases 2 and 3.

River Conveyance with Combined WTPs Alternative

Most features are the same as those described for the Preferred Alternative, except the Anthony Area WTP and associated diversion would not be constructed, and the Upper Valley WTP would have a larger treatment capacity. The proposed Upper Valley WTP would serve as a combined plant for the Upper Valley, Texas, and Anthony, New Mexico, service areas. The Upper Valley Diversion would be designed to supply 96 mgd (4.2 cms), instead of 80 mgd (3.5 cms), of raw water for treatment at the Upper Valley WTP. The El Paso Aqueduct would convey an additional 16 mgd (0.7 cms) of treated water via a new pipeline north to the Anthony, New Mexico area for distribution.

Under this alternative, the Rio Grande flows would be identical to the Preferred Alternative in all reaches with one exception: the reach between the Anthony WTP and the Upper Valley WTP would have slightly higher flows year-round. The average monthly flows would be higher by approximately 7 cfs (0.2 cms) in Phases 2 and 3 during the secondary irrigation season (November through February) and 9 cfs (0.3 cms) in Phases 2 and 3 during the primary irrigation season (March through October).

Aqueduct Conveyance with Local WTPs Alternative

The project features are the same as for the Preferred Alternative, differing primarily in the location of the proposed Las Cruces Area WTP, the number of new diversion structures, and the manner in which raw river water would be delivered to the Anthony Area WTP and the Upper Valley Area WTP. The WTPs would be the same as for the Preferred Alternative, except the Las Cruces Area WTP would be located at the Leasburg Site (near Leasburg Diversion), not the Interstate-10 Site, and water for the Anthony Area and Upper Valley WTPs would be diverted at an existing structure (Mesilla Diversion) and conveyed via new pipelines for treatment. The only new diversion under this alternative would be the Hatch Diversion.

Under this alternative, the New Mexico–Texas Aqueduct would be constructed. Water conveyed in the 25-mi-long (40 km) aqueduct would be diverted from the Rio Grande at the existing Mesilla Diversion. Water would be stored initially in the proposed Westside Reservoir, a regulating reservoir near the Mesilla Diversion at the head of the existing Westside Canal. The aqueduct would convey raw water from the Westside Reservoir to the Anthony Area and Upper Valley WTPs via two pipelines. Water conveyed to these WTPs would be treated and distributed the same as described under the Preferred Alternative.

Fish and wildlife mitigation measures would be the same as described for the Preferred Alternative, with one addition: 8 acres (ac) (3.2 hectares [ha]) of wetlands mitigation would be required for impacting about 4 ac (1.6 ha) of wetland habitat at the proposed Westside Reservoir site.

The Rio Grande flows for this alternative and the Aqueduct Conveyance with Combined WTPs Alternative (described below) are the same. Compared with the Preferred Alternative, the average releases from Caballo Dam during the secondary irrigation season (November through February) for these two alternatives would be approximately 15 percent higher for all phases. During the secondary irrigation season, flows would be higher upstream of Mesilla Dam, lower downstream to the Upper Valley WTP, and higher downstream of the Upper Valley WTP than with the Preferred Alternative. Flows during the primary irrigation (March through October) would be similar to the Preferred Alternative, except between Mesilla Dam and the Upper Valley WTP, where flows associated with both “Aqueduct” Alternatives would be lower.

Aqueduct Conveyance with Combined WTPs Alternative

This alternative is a combination of two alternatives. The aqueduct feature is the same as in the Aqueduct Conveyance with Local WTPs Alternative, and the combined plant feature is the same as in the River Conveyance with Combined WTPs Alternative.

No Action Alternative

With the No Action Alternative, none of the project features or phasing proposed for the action alternatives would be implemented. Existing water supply conditions in the El Paso–Las Cruces region would continue into the future, eventually resulting in drinking water shortages, and the needs and purposes of the project would not be met. Average releases from Caballo Dam during the secondary irrigation season (November through February) would be approximately 161 to 167 cfs (4.6 to 4.7 cms), which is 21 to 27 percent higher than baseline (107 cfs; 3 cms). Average releases from Caballo Dam during the primary irrigation season (March through October) would be similar to the Preferred Alternative.

EVALUATION METHODOLOGY

Since February 1998, the Service has attended monthly meetings as a member of the Steering Committee, held by the Commission, to discuss project features, design, and construction methods. The Service has participated by collecting main channel fisheries data in the Rio Grande from Percha Dam, New Mexico, to approximately five mi (8 km) downstream of the Jonathan Rogers Water Treatment Plant, El Paso, Texas. An extensive literature review was conducted by CH2M HILL as well as ongoing inventories for baseline fish and wildlife resources in the project area. A qualitative wildlife habitat rating system (WHAP: Wildlife Habitat Appraisal Procedure) was developed to assess wildlife habitat value by land type in the project area. Additional biological information were derived from unpublished data.

To understand the potential impacts of the project from changes in flows, an operational water model (Boyle Engineering Corporation and Parsons Engineering Science 2000) and an Instream Flow Incremental Methodology (IFIM) study model (CH2M HILL 2000) were prepared for this project to determine habitat losses and gains. Two habitat parameters were selected to determine aquatic habitat losses and gains in the Rio Grande from changes in river flow associated with the alternatives. The first parameter is shallow water habitat (less than 6 inches [in]; 15 centimeters [cm]) deep; the second is total exposed bottom area (islands, sandbars, shore).

EXISTING FISH AND WILDLIFE RESOURCES

Under current management, discharges from Caballo and Elephant Butte Reservoirs are ceased entirely during much of the secondary irrigation season (November to February). Flows in the river are reduced to seepage and minor ground water accretion downstream of Caballo Dam. Winter flows near the town of Hatch are typically about 20 cfs (0.6 cms). Flows at Mesilla Dam are about 50 cfs (1.4 cms) and accrete to about 160 cfs (4.5 cms) below American Diversion. With the project and under the No Action Alternative, these winter flows would increase. Primary irrigation season flows from March through October, which now are typically 1,000 to 2,500 cfs (28.3 to 70.8 cms), would be reduced. However, because the primary irrigation season is longer than the secondary irrigation season, the reduction in flows in the primary irrigation season would tend to be less than the gains in the non-irrigation season.

In reviewing habitat modeling results for the criteria sets (see Appendix 10-F in CH2M HILL and Geo-Marine, Inc. 2000), there is little slower velocity (0 to 0.75 ft per second [fps]; 0 to 0.23 m per second [mps]) habitat, even at lower flows. There is a dominance of faster (greater than 1.51 fps [0.46 mps])/deeper (greater than 3.01 ft [0.92 m]) habitat. At flows above 400 cfs (11.3 cms), there is little moderate (0.76 to 1.50 fps [0.23 to 0.45 mps]) or slow velocity habitat, and at flows above 700 cfs (19.8 cms) there is essentially no shallow (0 to 1 ft [0 to 0.3 m]) habitat. Above 1,500 cfs (42.4 cms) more than half of the habitat is unsuitable for fish (Figure 2).

To assess the influence of various flows on the fish community, the assessment was separated into three life stages (juvenile, adult, spawning) with the understanding that a sufficient amount of suitable habitat for all life stages of a particular species must be available in order for the species' population to persist.

Most juvenile fish, which are small by definition, prefer habitat that tends to be shallow and slow. In comparing this preference to habitat availability, it is clear that juvenile habitat is extremely limited at flows above 500 cfs (14.2 cms) in the Rio Grande. More juvenile habitat (as a percentage of wetted surface area) exists at the lowest flows, but the amount of wetted surface, and thus total habitat area for juveniles, is less at the lower flows. For example, at 50 cfs (1.4 cms), the average wetted width of stream is only about 100 ft (30 m) compared to 200 ft (61 m) at 500 cfs (14.2 cms). Thus, the lower flows provide a better mix of preferred habitat for most juvenile fish, but at the expense of total habitat area. However, total habitat area is not the major factor affecting fish in the Rio Grande. Quiet water less than 3 ft (0.9 m) deep is highly preferred habitat by most juvenile fish; these habitats appear to be most available at flows greater than or equal to 100 cfs (2.8 cms), but are essentially non-existent at 500 cfs (14.2 cms). This reflects the uniformity of the existing channel morphology and the lack of instream features, such as woody debris that would otherwise create this type of habitat.



Figure 2. Side channel and low velocity habitats used by fish are limited in the Rio Grande project area, particularly at higher flows.

For larger fish, referred to as adults, the habitat preferences are more diverse, but tend toward deeper, moderate velocity water compared to juveniles. There does appear to be some overlap in preferred habitat for both juveniles and adults at flows greater than 100 cfs (2.8 cms), but much lower than 500 cfs (14.2 cms). There is rearing habitat available, primarily at moderate flows near 500 cfs (14.2 cms), for only a few larger-sized species such as common carp (*Cyprinus carpio*) and river carpsucker (*Carpionodes carpio*).

For spawning, nearly all of the fish species require quiet water of at least moderate (1 ft; 0.3 m) depth. This habitat is limited at any flow, and particularly at higher flows typical of the early irrigation season from March to June when most species spawn. There is some native species spawning habitat at 100 cfs (2.8 cms) and likely more at slightly higher flows, but is extremely limiting at flows above 500 cfs (14.2 cms). Lack of suitable spawning habitat is undoubtedly a major contributing factor to the poor condition of the Rio Grande fishery.

Shallow water habitats and exposed bottom areas of the Rio Grande are used by many species of wintering migratory birds (Figure 3). Sandbars and exposed bottom areas are also used by turtles for basking and for hibernation in winter. Much of the Rio Grande channel bottom is exposed during winter low flow periods. At flows of 50 cfs (1.4 cms), about 40 percent of the channel consists of sandbars. These are generally large areas, rather than a series of small bars, and they tend to be on one side of the river or the other. The flowing water tends to be along one bank, but migrates across the channel. There are many areas with

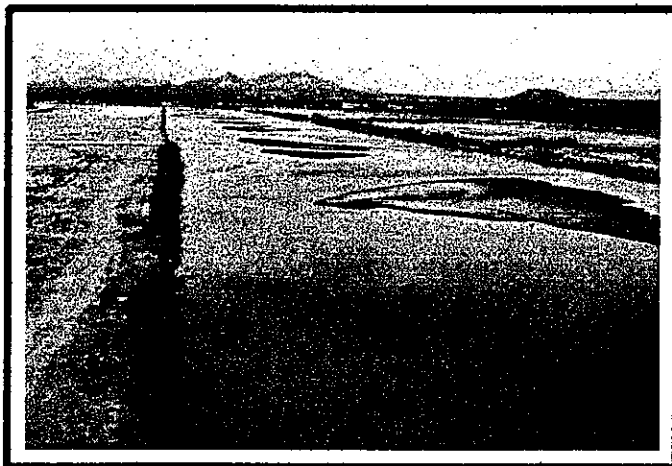


Figure 3. Shallow water habitats and exposed bottom areas of the Rio Grande are used by many species of wintering migratory birds and by turtles for basking and for hibernation in winter.

slow-moving water. At 300 cfs (8.5 cms), only about 10 percent of the channel consists of sandbars, generally large sand bars, but smaller and fewer than at lower flows. There are very few areas with quiet or slow-moving water at 300 cfs (8.5 cms). The entire channel is flooded when flows are greater than about 500 cfs (14.2 cms). An unknown number of spiny softshell turtles (*Trionx spiniferus*) may not over-winter in areas where sandbars are flooded. Flooded sandbars may also displace wintering shorebirds such as killdeer (*Charadrius vociferus*) and least sandpipers (*Calidris minutilla*). Based upon IFIM modeling results and survey data, winter flows between 100 to 300 cfs (2.8 to 8.5 cms) provide the most suitable habitat for a variety of species; suitable winter habitat for most species decreases at flows less than 100 cfs (2.8 cms) and greater than 300 cfs (8.5 cms).

Aquatic Resources

The aquatic resources in the Rio Grande evolved to live in a system that is very different than what currently exists. Reservoir operations at Elephant Butte and Caballo Dams, the entrenched canalized channel, and several major diversion structures have created an aquatic system that limits the fishery downstream of the dams to El Paso and beyond. Consequently, the existing aquatic communities in the project area differ from those that occurred historically (Crawford *et al.* 1993). A list of common and scientific names of fish that may occur in the Rio Grande project area is provided in Appendix A.

The loss of many native fish species in the Rio Grande illustrates that the hydrologic and morphological changes in the channel have had a major impact on aquatic resources. The native ichthyofauna of the New Mexico portion of the Rio Grande is believed to have consisted of between 16 and 27 species (Hatch 1985, Smith and Miller 1986, and Propst *et al.* 1987, Rinne and Platania 1995, Sublette *et al.* 1990), five of which were endemic to the basin. Of the latter, the Rio Grande shiner (*Notropis jemezianus*), phantom shiner (*Notropis orca*), speckled chub (*Extrarius aestivalis*), and Rio Grande bluntnose shiner (*Notropis simus simus*) are extirpated from the New Mexico portion of the Rio Grande. The Rio Grande silvery minnow (*Hybognathus amarus*) is the only surviving Rio Grande species in New Mexico and occurs upstream of Elephant Butte Reservoir in less than 5 percent of its total former range (Bestgen and Platania 1991).

The Rio Grande between Elephant Butte Dam and Caballo Reservoir supports a variety of fish species. Propst *et al.* (1987) reported 26 fish species, including 6 native species. Common game fish included rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), channel catfish, striped bass (*Morone saxatilis*), bluegill, largemouth bass, white crappie, yellow perch, and walleye. Hence, the fishery in this section of river is varied and includes cold-water species in the upper reach, and a mixed warm- and cold-water fishery in the middle and lower reaches. The popular cold-water fishery is dependent on stocking of rainbow trout by the NMDGF, and on cold water released from the bottom of the reservoir during the irrigation season. Downstream of the tailwater fishery, several fish species invade the river from Caballo Reservoir. These fish include striped bass, white bass, walleye, and catfish. When the river is low in late fall and winter, large pools form that contain large numbers of fish, including striped bass, catfish, and walleye. However, with releases discontinued from Elephant Butte Dam (usually October 1 to February 28), these pools are maintained only by local bank accretion and may be short-lived.

The Rio Grande between Caballo Dam and El Paso supports a fish community consisting of at least 22 known species (Appendix A), eight of which are native (Figure 4). Each of these native species is known to be tolerant of disturbed habitat. Historically, this reach of the Rio Grande supported 18 native species (Propst *et al.* 1987), but most of these have been eliminated or are now found in low abundance because of the severity of habitat alteration as well as the introduction of competing non-native species. Of the non-native species found in the river, many probably originate from the upstream Elephant Butte and Caballo Reservoirs; and many more probably originate from the drains and laterals, particularly bass and sunfish (Figure 5). Carp, catfish, red shiners, bullhead minnows, and western mosquitofish are probably self-sustaining populations.

The Service's New Mexico Ecological Services Field Office (NMESFO) and New Mexico Fishery Resources Office (NMFRO) conducted seasonal sampling of fish in the Rio Grande in the project area between September 1998 and July 2000. Additional fish surveys were

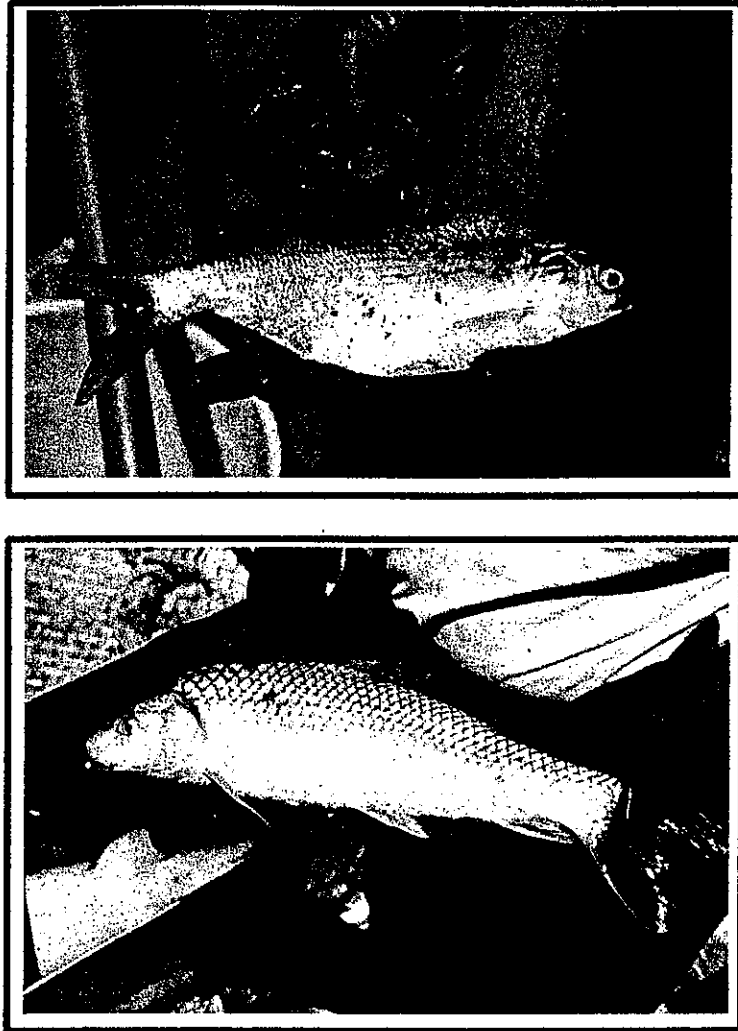


Figure 4. Gizzard shad (*Dorosoma cepedianum*) (above) and river carpsucker (*Carpiodes carpio*) (below) are both native fish species found in the Rio Grande within the project area.



Figure 5. Longear sunfish (*Lepomis megalotis*) are an introduced species in the Rio Grande within the project area.

conducted in drains to the Rio Grande by CH2M HILL in the Texas portion of the project area. The NMFR0 sampled from near Percha Dam to approximately 0.5 mi (0.8 km) downstream of State Highway 140 bridge, Rincon, New Mexico (Jackson and Smith 2000), while NMESFO sampled from approximately 4.5 mi (7.2 km) downstream of State Highway 140 bridge, near Rincon, New Mexico, to approximately 5.0 mi (8.0 km) downstream of the Zaragosa International Bridge crossing, in El Paso, Texas. Twenty-one fish species were collected in the Rio Grande. Species abundance and diversity were similar between the NMESFO and NMFR0 collections with red shiners, bullhead minnows, and western mosquitofish being the most abundant species. Spotted bass were the most commonly collected large species in upstream reaches, while common carp were the most common in downstream reaches. The most abundant large native species was the flathead catfish (Figure 6).

In winter, more large specimens were collected near Sunland Park, New Mexico, likely because of the higher flows and availability of deeper habitats. During the primary irrigation season (high flow collections) species diversity and abundance were highest in the upstream reaches near mitigation structures that often provided the only habitat diversity (Jackson and Smith 2000). In the lower reaches, species diversity and abundance were frequently highest in flooded irrigation returns that often provided the only low velocity habitat and habitat diversity. Threadfin shad, golden shiner, and yellow perch were collected only in the upstream reaches; these species likely originated from Caballo Reservoir.



Figure 6. Flathead catfish (*Pylodictis olivaris*) were the most abundant large native species collected in the Rio Grande within the project area.

Only six fish species were collected during drain surveys in Texas. The four drains surveyed were Island Drain, Middle Drain, Montoya Drain, and Tornillo Drain. These species included western mosquitofish, red shiner, bullhead minnow, common carp, longear sunfish, and bass. The most commonly collected species, western mosquitofish and red shiner, are both native species that are highly tolerant of disturbed habitat.

In April 1992, the NMDGF sampled several drains near Las Cruces, New Mexico. These included Del Rio Drain (two sites), Picacho Drain, and Mesilla Lateral. Ten fish species were collected including gizzard shad, common carp, bullhead minnow, red shiner, river carpsucker, bullhead catfish, channel catfish, western mosquitofish, largemouth bass, and bluegill. Del Rio drain had the highest numbers and diversity of species (10): bluegill and red shiner were most abundant. Though many of the same species were collected in both New Mexico and Texas drains, the higher species diversity in New Mexico indicates much better habitat quality, particularly in Del Rio Drain.

The NMDGF does not manage the river fishery below Caballo Dam for any particular species. Sport fishing is considered poor at present and there are no known threatened and endangered fish species requiring special attention in this reach of river. However, protecting and enhancing the native fish community is an objective of the NMDGF and the Service.

Elephant Butte and Caballo Reservoirs presently support 32 fish species representing 11 families (CH2M HILL and Geo-Marine, Inc. 2000). Of these species, only 9 are native to the

Rio Grande Basin, and the other 23 have been introduced from other river basins by various means. Thirty of the 32 fish species are warm-water species and 2 (rainbow trout and brown trout) are cold-water forms.

The primary fish species sought by anglers in Elephant Butte Reservoir are largemouth bass, smallmouth bass (*Micropterus dolomieu*), white bass, channel catfish, and striped bass. Other fish species that are occasionally caught include bluegill, black crappie (*Pomoxis nigromaculatus*), white crappie, longear sunfish, and green sunfish. Walleye, though sometimes abundant, appear only sporadically in angler catches. Blue catfish (*Ictalurus furcatus*) and flathead catfish are also popular game fish. Caballo Reservoir supports a similar, though less popular warm-water fishery. Caballo Reservoir is stocked with walleye and provides for a good walleye fishery. The NMDGF has abandoned its striped bass stocking program on Caballo Reservoir, primarily because of low survival rates of stocked fish caused by variable reservoir levels.

Terrestrial Resources

Vegetation

The vegetation types that historically dominated the project area included Trans-Pecos shrub savanna, grama-tobosa desert grasslands, oak-juniper woodlands, and mesquite tarbush desert (McNab and Avers 1994). Cattle grazing, urban development, and mining have been the main causes of disturbance. Currently, the native vegetation in this area is characterized by predominately arid grass and shrub species. A list of common and scientific names of vegetation discussed in this report is provided in Appendix B.

Dick-Peddie (1993) mapped three vegetation communities within the proposed project features in Doña Ana and Sierra Counties: 1) urban and cultivated areas, 2) Chihuahuan Desert scrub, and 3) desert grassland. There are no detailed vegetation descriptions available for the urban and cultivated areas (CH2M HILL and Geo-Marine, Inc. 2000). Chihuahuan Desert scrub dominates vegetation communities in the Chihuahuan Desert of New Mexico and Texas. The dominant plant of the Chihuahuan Desert scrub is creosotebush. Other common plants of this community include tarbush, ocotillo, fluff grass, black grama, alkali sacaton, and bush muhly. Overgrazing on grasslands has resulted in increased shrub densities and extensive reductions in black grama and other grasses. The desert grassland series includes: black grama, mesa dropseed, giant sacaton, gypgrass, alkali sacaton, and curlyleaf muhly. The high number of habitat types (23) associated with these 6 desert grassland series results from its floristic diversity, wide elevation range, and adaptation to many soils and land forms (CH2M HILL and Geo-Marine, Inc. 2000).

Prior to large scale water diversion and management and channelization, the Rio Grande floodplain developed unique communities of mixed riverine tree/shrub/grassland dependent upon periodic flooding. Before farmlands dominated the land, thickets or bosques lined the

river. A major historical component of native vegetation along the Rio Grande was the Rio Grande cottonwood-Goodding's willow woodland. This deciduous woodland is best developed along alluvial floodplains of large, low-gradient, perennial streams that flow through wide, unconstrained valleys. The vegetation is dependant on a subsurface water supply and varies considerably with the height of the water table. Major flood events and consequent flood scour, overbank deposition of water and sediments, and stream meandering are important factors that shape this community (USGS 1998).

The cumulative habitat alterations, combined with large-scale water diversion, have eliminated most of the native wetland and riparian communities along the Rio Grande. Most of the floodplain of the Rio Grande has been replaced by row crops and orchards. Remaining portions of the floodplain within the levees are managed to control riparian vegetation to maintain flood capacity. The river corridor is now composed predominately of saltgrass and Bermuda grass. The common and scientific names of plants that may occur in the floodplain of the project area is provided in Chapter 3 of the Biological Resources Technical Report (CH2M HILL and Geo-Marine, Inc. 2000).

Elephant Butte and Caballo Reservoirs are located in the Chihuahuan Desert (Brown 1982; Dick-Peddie 1993). Creosotebush is the dominant plant species in terms of overall cover in the desert scrub, while grasses comprise the greatest percentage of cover in the desert grassland. Four plant communities (creosotebush shrubland, juniper woodland, mesquite shrubland, and mixed desert shrubland) along with barren or very low density and disturbed or managed vegetation areas are found around Elephant Butte and Caballo Reservoirs or along the Rio Grande between both reservoirs.

Creosotebush shrubland is the most prevalent vegetation community along the shoreline in both reservoirs. This terrestrial community includes areas that are dominated by creosotebush or areas where this species is relatively low in density, but remains the dominant shrub. Other prominent species include bunch grasses, shrubs, and forbs. Bunch grasses, such as black, blue, sideoats, and six-weeks grama, spike and mesa dropseed, tobosa, are often subdominant or even higher in total aerial cover. Tarbush is a co-dominant shrub in a few areas along with the following variety of shrubs and subshrubs: broom snakeweed, ocotillo, sotol, soaptree and banana yucca. Even though forbs make up only a small percentage of the total aerial vegetation cover, they are quite diverse. Representative species include red globemallow, desert marigold, dogweed, and desert holly.

Riparian wetland communities comprise the majority of the vegetation community along the Rio Grande between Elephant Butte and Caballo Reservoirs. Mesquite shrubland and mixed desert shrubland are found in extremely low densities along the Rio Grande.

Past and present land use is the critical factor determining vegetation structure and composition within the river corridor. Because the majority of the corridor is maintained

through mowing, the vegetation community is predominantly saltgrass and Bermuda grass with some shrub encroachment. Sites that have been heavily grazed have sparse, shrubby cover with little herbaceous vegetation. Areas where there were no constructed levees because of topographic relief were dominated by a nearly-closed canopy of shrubs. Some areas were used for agricultural purposes, such as row crops and pecan orchards.

The entire river corridor below American Dam, with one exception, is composed of grassland (saltgrass/Bermuda grass). The exception is a concrete lined section of the Rio Grande which begins just upstream from the Bridge of the Americas and continues downstream for about 3 mi (4.8 km) that did not contain a vegetative floodplain. The vegetation community along the Rio Grande below the Riverside Diversion Dam is predominantly salt cedar, but provides the only woody riparian habitat in the area.

Mammals

CH2M HILL and Geo-Marine, Inc. (2000) performed mammal surveys in selected portions of the project area during January, May, June, and August 1999. In the Rio Grande corridor, the most common mammals observed were coyotes, raccoons, and striped skunks. Other mammals observed were mule deer, beaver, muskrat, bobcat, gray fox, desert cottontails, and black-tailed jackrabbits. Mammals crossed the river or used the sandbars at most of the sites. Deer crossed the river or used sandbars at six of the seven sites where they were observed. The sites in the northern sections of the corridor (upstream of Las Cruces) had a larger diversity of native mammals. Only domestic mammals were observed at the most southern sites (in El Paso). A list of common and scientific names of mammals discussed in this report is provided in Appendix C.

Other mammals observed in the project area included western pipistrelle bat, rock squirrel, spotted ground squirrel, and Botta's pocket gopher. Little information is available on mammalian use of agricultural lands in the Chihuahuan Desert (CH2M HILL and Geo-Marine, Inc. 2000). However, it is likely that more species occur than were observed because a comprehensive inventory would require more intensive surveys conducted throughout the day and year. A list of common and scientific names of mammals that potentially occur in the project area is provided in Table 7-3.1 of the Biological Resources Technical Report (CH2M HILL and Geo-Marine, Inc. 2000).

Birds

The Rio Grande Valley lies within the Central Flyway Zone and attracts large numbers of waterfowl. The diversity of avian species that seasonally frequent the Rio Grande Valley is high because of the variable habitats associated with the Rio Grande floodplain; the location of the reservoirs within a migratory corridor along the Rio Grande; and the proximity to the Bosque del Apache National Wildlife Refuge, which attracts large numbers of birds. Fitzsimmons (1955) and Raitt *et al.* (1981) documented more than 250 species of birds within the general area. Many of these species are associated with riparian-wetland habitats

and include waterfowl, raptors, and neotropical migrant songbirds. A list of common and scientific names of birds discussed in this report is provided in Appendix D.

CH2M HILL and Geo-Marine, Inc. (2000) conducted waterfowl and shorebird surveys in winter and spring 1999. Eighteen species of waterfowl were observed during winter surveys. Green-winged teal, mallard, gadwall, and northern shoveler were the most abundant puddle ducks, while common merganser was the only common diving duck. Segment II (near the head of Selden Canyon to SH-185 bridge south of Arrey) waterfowl numbers were higher than those in Segment I (El Paso Electric Rio Grande Power Plant to Rio Grande Bridge below Leasburg Dam). Comparing waterfowl per river mile, duck density was nearly four times higher in Segment II (97.9 per mi; 157.5 per km) than Segment I (23.5 per mi; 37.8 per km). Based on these data, Segment II is an important wintering area for ducks, in the project area.

Twelve migrant duck species were observed during spring 1999 surveys. Green-winged teal and mallard were the most abundant duck species observed. Puddle ducks, with the exception of northern pintail, were present during each survey. Three diving ducks, redhead, lesser scaup, and common goldeneye, were found only during week No. 2 surveys. The abundance of other migrant duck species was low.

In winter, waterfowl in the project area fed and loafed in the Rio Grande. In order of decreasing percent composition, waterfowl used river, shore, and sandbar habitats for roosting (CH2M HILL and Geo-Marine, Inc. 2000). Water level and water velocity were identified as influencing migratory bird use during spring. Duck numbers were lower in areas with higher water levels and higher water velocities north of Selden Canyon. Conversely, duck numbers were higher in areas with lower water levels and lower water velocities south of Selden Canyon.

Eight species of wintering shorebirds were found during winter surveys between American and Caballo Dams. These included killdeer, black-necked stilt, greater yellowlegs, lesser yellowlegs, spotted sandpiper, least sandpiper, long-billed dowitcher, and common snipe. Least sandpiper and killdeer were the most abundant wintering shorebirds in each segment and comprised more than 85 to 90 percent of the shorebirds found during each survey. Least sandpiper percent composition was higher in Segment II. By comparing the number of individuals per river mile, least sandpiper appeared to prefer the habitat in Segment II (9.8 per mi; 15.8 per km) over Segment I (6.1 per mi; 9.8 per km). However, killdeer appear to be distributed relatively evenly between the segments. Black-necked stilt and long-billed dowitcher were found only in Segment I and lesser yellowlegs were found only in Segment II. Killdeer and black-necked stilt nest in the project area (CH2M HILL and Geo-Marine, Inc. 2000; National Geographic Society 1999). All remaining shorebirds winter in the project area and nest in northern North America.

During the last week of the winter surveys total shorebird numbers in Segment II declined from 487 to 186 during the first 300 cfs (8.5 cms) flush flow of 1999. Prior to the flush flow, shorebird totals were relatively constant between surveys. Flows increased at Percha Dam from approximately 10 to 300 cfs (0.3 to 8.5 cms) the last two days of the survey. The decrease in shorebirds numbers was likely in response to the inundation of suitable habitat.

Killdeer are an opportunistic feeder and an open-habitat generalist that used all available feeding habitats in the project area. Although some killdeer fed in the very still, shallow water of the river, most individuals used sandbar habitat for feeding. In contrast, least sandpiper were observed feeding primarily in the shallow, slow-moving water of the river. Both of these habitat types are characteristic of winter conditions in the Rio Grande.

Shorebird use of the Rio Grande in March appears to be almost non-existent because of high flows and water levels. In fact, only one spotted sandpiper was found during spring surveys.

A variety of habitat types associated with various project features were also surveyed in the project area including agricultural, Chihuahuan desert scrub, honey mesquite, grassland, farmland (fallow and with crops), and urban habitats (see Appendix 6-C, *Occurrence and Abundance of Birds in the Project Area*, DEIS 2000). These surveys were typically one time reconnaissance-level surveys or multiple surveys during one season and are not a comprehensive inventory.

Common species in agricultural habitats might include killdeer, American kestrel, rock dove, mourning dove, northern mockingbird, western meadowlark, and red-winged blackbird throughout the year, and horned lark and American pipit in winter. Permanent residents in Chihuahuan desert scrub might include red-tailed hawk, verdin, cactus wren, northern mockingbird, and black-throated sparrow. In summer, potentially common species would include ash-throated flycatcher and Scott's oriole. In honey mesquite habitats, red-tailed hawk, mourning dove, greater roadrunner, black-chinned hummingbird, ladder-backed woodpecker, verdin, northern mockingbird, and pyrrhuloxia might be present all year. A wide variety of migratory and winter resident bird species would potentially use the honey mesquite community (CH2M HILL and Geo-Marine, Inc. 2000). Common resident birds in the saltgrass/Bermuda grass community might include Gambel's quail, killdeer, mourning dove, barn swallows, western meadowlark, and house finch. A wide variety of winter resident hawks (e.g., red-tailed and ferruginous), falcons (American kestrel), and sparrows (song and white-crowned) would be expected to occur in this habitat. As many as 75 species might occur in farmland and urban habitats (CH2M HILL and Geo-Marine, Inc. 2000). Common resident species would include great blue heron, great-tailed grackle, mourning dove, turkey vulture, and house sparrow.

Wildlife surveys of crop (onions, cotton, alfalfa, hay, pecans) habitat were conducted in March, April, May and September 1999 to assess use of agricultural land in the project area

(CH2M HILL and Geo-Marine, Inc. 2000). Birds were not found during surveys of dry, early season onion fields (March), and dry or wet early season cotton fields (May). Two mallards and three greater yellowlegs were observed during surveys of wet, early season onion fields, and sixteen red-winged blackbirds were observed in dry, late season onion fields (May). One raven was observed in an early season hay field and twenty-four red-winged blackbirds in a late season hay field. Twelve bird species (ducks, shorebirds, gulls, etc.) were found in irrigated (wet) alfalfa fields, but only two bird species were observed (chipping sparrow and western meadowlark) in two dry alfalfa fields. Twenty bird species were observed in pecan orchards. Of the 16 bird species observed in early season pecan orchards 6 were neotropical migrants, 8 were permanent residents, and 2 were winter residents; 12 species were observed in late season pecans. One immature bald eagle and several red-tailed hawks were observed perched in pecan orchards during winter waterfowl and shorebird surveys.

Based on the wildlife habitat ranking (WHAP values) developed specifically for the project, most agricultural crops (alfalfa, onions, cotton, hay) grown in the project area provide below-average to poor wildlife habitat. Pecan orchards provide the best agricultural wildlife habitat in the project area. When compared to native habitat, alfalfa fields and pecan orchards are both below-average wildlife habitat. However, irrigated alfalfa fields and pecan orchards provide slightly higher wildlife habitat values than other cover types and, as a result, are used more by wildlife. Cover types such as onions, cotton, and hay generally had low WHAP values, low species diversity, few individuals, and lower wildlife habitat ranks.

Hink and Ohmart (1984), found that riparian areas are used heavily by most bird species in New Mexico. Cottonwood-dominated community types are used by large numbers of bird species, and are preferred habitat for a large proportion of the species, especially during breeding season. Bird density appears to be strongly related to density of foliage, regardless of species composition of the plant community. Marshes, drains, and areas of open water contribute to the diversity of the riparian ecosystem as a whole because of their strong attraction for water-loving birds. At various times of the year, these areas support the highest bird densities and species numbers in other portions Rio Grande. However, riparian habitat in the project area is extremely limited.

Since there are little or no wetlands in the project area, the reservoirs, the river, laterals and drains, and arroyos in and near the project area provide habitat, on a seasonal basis, for a variety of waterfowl. A list of common and scientific names of birds that may occur in the Rio Grande floodplain is provided in Tables 6-3.1 and 6-3.3 of the Biological Resources Technical Report (CH2M HILL and Geo-Marine, Inc. 2000).

Amphibians and Reptiles

CH2M HILL and Geo-Marine, Inc. (2000) documented 32 herptile species (amphibians and reptiles) in the project area during spring 1999 surveys. These included two turtle species,

eleven lizard species, three toad species, one frog species, and two snake species. In the river corridor, the most abundant species observed was the bullfrog. Also abundant in the project area were whiptail lizards (six species), Woodhouse's toad, and spiny softshell turtles: these species are typically abundant in disturbed areas. More species likely occur than were observed because a comprehensive inventory would require surveys conducted throughout the day and year. A list of common and scientific names of amphibians and reptiles discussed in this report is provided in Appendix E.

Most amphibians depend on the aquatic habitat of riparian areas for at least a portion of their life cycle. Amphibians associated with wetter riparian areas with wet meadows and marshes are chorus frogs, leopard frogs, and bullfrogs (Crawford *et al.* 1993). Their presence is limited in the project area by a lack of wet meadows and marshes. However, the survey site near Rincon and Hatch had the highest density and diversity of amphibians and reptiles. This area had a large pool off the Rio Grande, formed by a sandbar close to the river's edge, that provided the most natural wetland and pool habitat of all the sites. Amphibians common in Chihuahuan desert habitats include the tiger salamander, Great Plains toad, Woodhouse's toad, western green toad, red-spotted toad, Couch's spadefoot, plains spadefoot, and bullfrog.

Reptiles typically found in Chihuahuan desert habitats include the spiny softshell turtle, desert box turtle, whiptail (six species), lizards (nine species), western blind snake, ground snake, western diamondback rattlesnake, and Sonoran gopher snake. A list of common and scientific names of amphibians and reptiles that may occur in the project area is provided in Tables 5-3.1 and 5-3.3 of the Biological Resources Technical Report (CH2M HILL and Geo-Marine, Inc. 2000).

In general, the agricultural areas within the project area are disturbed and provide low quality habitat for herptiles. However, the irrigation drains and canals provide habitat and breeding areas for amphibians. Management practices of the Rio Grande floodplain have also resulted in decreased quality of habitat along the river. Mowing and burning have restricted the growth of native shrubs and trees, such as mesquite and cottonwood, which support many herptile species in the area. These management practices also have resulted in enhancing the growth of introduced grasses, such as Bermuda grass, which provide limited habitat for herptiles. Native habitats, such as is present at the Westside Regulating Reservoir site and the El Paso Aqueduct corridor, provide high quality habitat for herptiles.

Threatened and Endangered Species

As the quality and quantity of the fish and wildlife habitat within the Rio Grande has decreased over time, so has its ability to sustain native flora and fauna. Several species endemic to the valley have been listed on the Federal threatened and endangered species list under the Endangered Species Act. Information is provided in this CAR concerning those listed species that could be present; southwestern willow flycatcher and bald eagle.

Southwestern Willow Flycatcher

The Service listed the southwestern willow flycatcher (flycatcher) as endangered on February 27, 1995 (Service 1995a). The flycatcher is also classified as endangered (Group I) by the State of New Mexico (New Mexico Department of Game and Fish 1987). The current range of the flycatcher includes southern California, southern portions of Nevada and Utah, Arizona, New Mexico, western Texas, and southwestern Colorado (Unitt 1987; Browning 1993). Critical habitat for the flycatcher was designated July 22, 1997; however, the proposed project area is not within designated critical habitat. In New Mexico, the species has been observed in the Rio Grande, Rio Chama, Zuni, San Francisco, and Gila River drainages. Available habitat and overall numbers have declined statewide (Service 1997).

Loss and modification of nesting habitat is the primary threat to this species (Phillips *et al.* 1964; Unitt 1987; Service 1993). Loss of habitat used during migration also threatens the flycatcher's survival. Large scale losses of southwestern wetlands have occurred, particularly the cottonwood-willow riparian habitats used by the flycatcher (Phillips *et al.* 1964; Carothers 1977; Rea 1983; Johnson and Haight 1984; Howe and Knopf 1991).

The flycatcher is a riparian obligate and nests in riparian thickets associated with streams and other wetlands where dense growth of willow, buttonbush, boxelder, Russian olive, salt cedar, or other plants are present. Nests are often associated with an overstory of scattered cottonwood. Throughout the flycatcher's range, these riparian habitats are now rare, widely separated by vast expanses of arid lands. Flycatchers nest in thickets of trees and shrubs approximately 6.6 to 22.9 ft (2 to 7 m) in height or taller, with a densely vegetated understory from ground or water surface level to 13.1 ft (4 m) or more in height. Surface water or saturated soil is usually present beneath or next to occupied thickets (Phillips *et al.* 1964; Muiznieks *et al.* 1994). At some nest sites, surface water may be present early in the breeding season with only damp soil present by late June or early July (Muiznieks *et al.* 1994; Sferra *et al.* 1995). Habitats not selected for either nesting or singing are narrower riparian zones, with greater distances between willow patches and individual willow plants. Suitable habitat adjacent to high gradient streams does not appear to be used for nesting. Areas not selected for nesting or singing may still be used during migration.

Flycatchers begin arriving in New Mexico in late April and May. Breeding begins in late spring, and young begin to fledge in early summer. Late nests and re-nests may not fledge young until late summer (Sogge and Tibbitts 1992; Sogge *et al.* 1993).

Occupied and potential flycatcher nesting habitat exists along the Rio Grande; however, only 30 breeding pairs (6 in the project area) were identified in the Rio Grande Basin in 1999 surveys. Occupied and potential habitat is primarily composed of riparian shrubs and trees, chiefly Goodding's willow and peachleaf willow, Rio Grande cottonwood, coyote willow, and salt cedar. The habitat within the Project area does provide nesting habitat for the flycatcher, and some flycatchers may use the area during migration. Habitat in nesting areas

has mature cottonwoods, often bordered or mixed with salt cedar and Russian olive, with small patches of willows along the high flow channels.

Bald Eagle

The project is within the known and historic range of the bald eagle. The Service reclassified the bald eagle from endangered to threatened on July 12, 1995 (Service 1995b). The Service proposed removing the bald eagle from the list of endangered and threatened wildlife on July 6, 1999 (Service 1999).

Wintering bald eagles frequent all major river systems in New Mexico from November through March, including the Rio Grande. The favored prey of bald eagles is fish, waterfowl, and small mammals. Bald eagles prefer to roost and perch in large trees near water. There are potential perch sites in the project vicinity where large cottonwoods occur at the river's edge. Two bald eagles were observed during each weekly winter waterfowl and shorebird survey in January 1999. Both birds were found along the Rio Grande in Doña Ana County, New Mexico. No bald eagles were observed during spring surveys along the Rio Grande (CH2M HILL and Geo-Marine, Inc. 2000).

FUTURE CONDITIONS WITHOUT THE PROJECT (No Action Alternative)

The No Action Alternative for this project is the affected environment with trends through the 30-year term of the project. Baseline biological conditions were projected through time to develop expected trends and future conditions.

Current trends in the project area include conversion of agricultural lands for municipal, industrial, and urban use. This conversion would be expected to continue throughout the project area. In addition, channelization, flow regime management of the Rio Grande, the removal of the floodplain vegetation for flood control (within the levees) and agricultural production (outside the levees) would also be expected to continue. Development would be concentrated between El Paso and Las Cruces and southeast of El Paso. Demand for water would continue to increase. Expected future trends for aquatic and terrestrial resources include the following:

- In New Mexico, irrigated croplands would continue without significant changes.
- Urbanization in Texas would continue to remove croplands from typical agricultural practices at a rate of about 700 ac (283 ha) per year.
- Drains would continue to provide some of the best aquatic and riparian habitat.
- Urbanization and continued conversion of water rights to municipal and industrial (M&I) uses would reduce the number of drains, drain flows, and drain habitat quality, though this would also be expected to occur to some extent with the Action Alternatives.
- Extreme water conservation measures could decrease wildlife habitat values within urban areas, though this could also occur with the Action Alternatives.
- Average monthly releases from Caballo Dam in the secondary irrigation season are expected to increase by approximately 50 percent above baseline (107 cfs, 1.4 cms) to about 161 to 164 cfs (4.6 cms) for all phases.
- Slightly higher secondary irrigation releases from Caballo Dam would increase winter fish and wildlife habitat.
- Lack of suitable riverine habitat and high primary irrigation season flows (though slightly reduced) would continue to limit aquatic species.

Because construction of the project would not occur with implementation of the No Action Alternative, there would be no associated short-term aquatic and terrestrial resource changes. Without construction of the WTPs, there would also be no associated long-term changes from permanent land use conversion. However, because the No Action Alternative is expected to differ from baseline conditions, there would be some changes to biological resources.

Higher secondary irrigation (November through February) flows during all phases would likely benefit aquatic resources by increasing wetted area and productivity. The increase in flows would also increase adult fish habitat. Yet, the fishery in the Rio Grande would

continue to be marginal because of continued high primary irrigation-season flows, which severely limit reproduction and suitable habitat for most species of fish and other aquatic organisms.

Increasing urbanization and development within the historic floodplain would continue to eliminate remnant riparian areas located outside the levees, while putting increased pressure on the habitat and wildlife in the riparian zone. Land use conversion would continue at a similar rate in Texas and at a slower rate in New Mexico compared with all of the Action Alternatives. In Texas, land use conversion with the No Action Alternative would be about 14,000 ac (5,666 ha) versus 14,344 ac (5,805 ha), or more, for the Action Alternatives by the end of Phase 2.

For Elephant Butte Reservoir, the predicted trend would be for average water levels to gradually increase by 1 to 2 ft (0.3 to 0.6 m) between Phases 1 and 3 under the No Action Alternative. Patterns of reservoir water level fluctuation within a year would be similar for each phase, generally being highest during February/March, June, and September/October. Maximum annual water level fluctuations between fall and early summer would be nearly the same each phase, ranging from 5 ft (1.5 m) in Phase 1 to 6 ft (1.8 m) in Phases 2 and 3. Water level fluctuations such as these, among months and project phases, together with a consistent pattern of water level fluctuation over the life of the project, would be expected to have little or no adverse effects on shoreline vegetation communities at Elephant Butte Reservoir.

The amount of suitable spawning habitat (defined by water less than 4 ft [1.2 m] deep); in Elephant Butte Reservoir generally increases as the water surface elevation increases. Within the typical 100-ft (30 m) operating elevation range between 4,300 ft and 4,400 ft (1,311 and 1,341 m), the area of water less than 4 ft (1.2 m) deep increases approximately three-fold, from about 600 ac (243 ha) to more than 1,800 ac (728 ha). Thus, there would be some expected increase in fish spawning areas.

For Caballo Reservoir, the predicted trend would be for average water levels to vary 0 to 1 ft (0 to 0.3 m) between Phases 1 and 3 under the No Action Alternative. Patterns of water level fluctuation within a year would be similar for each phase, generally being highest during May/June and October/November. Maximum annual water level fluctuations between fall and early summer would be 8 ft (2.8 m) for each phase. Water level fluctuations such as these, among months and project phases, together with a consistent pattern of water level fluctuation over the life of the project, would be expected to have little or no adverse effects on shoreline vegetation or fish communities at Caballo Reservoir.

In the long-term, future growth could be reduced because of an inadequate water supply and/or high water costs. The result would be a beneficial impact to native plant and other terrestrial communities since the trend of vegetation removal for development would be

reduced. Bird communities along the river corridor may benefit from slight increases in winter releases via increased productivity, though there would be some decrease in exposed river bottom area. Some resident species (e.g., mallard ducks) could decrease with the decrease in the quality and quantity of urban drains and associated habitats. Impacts to mammals would not be expected along the river corridor and associated irrigation drainages from changes in flows.

A current trend in the project area to use surface water to develop additional riparian habitat may no longer be possible, because any available water may be needed for M&I use. Thus, the rehabilitation of habitat necessary for species dependent upon these habitats would be more difficult. The decrease in the number of urban drains, drain flow, and suitable urban habitats because of urbanization and extreme water conservation measures (which would lower drain water levels and possibly decrease cover long term) would decrease the quality and quantity of habitat, though this is also expected to occur in some drains with the Preferred Alternative.

Threatened and Endangered Species

Suitable flycatcher habitat would continue to be limited in the project area. Without adequate cottonwood regeneration, bald eagle perch habitat would continue to decline, thus impacting the bald eagle. These issues will be addressed in detail during the section 7 consultation process.

IMPACTS TO FISH AND WILDLIFE RESOURCES WITH THE PROJECT

Impacts from the conversion of irrigated agricultural lands are discussed below. For planning purposes, it is assumed that the lands from which the water rights are converted would be used in the following manner:

- The bulk of orchards would continue to be developed for residential housing and other commercial purposes.
- It is estimated that no more than 20 percent of forage (alfalfa, hay) and annual croplands (cotton, onions) would be fallow. Based on the potential for other use of the land, it is probable that most of this land would be used for grazing, habitat enhancement, conservation easements, recreation, or other compatible uses.

Phase 1 (from present to year 2010)

During Phase 1 of this project it is estimated that 15,547 ac (6,292 ha) of irrigated agricultural lands would be converted to M&I or other uses as a direct result of implementing the Preferred Alternative. Approximately 6,100 ac (2,469 ha) would be in Texas, and 9,447 ac (3,823 ha) in New Mexico. Annual crops comprise 10,106 ac (6,292 ha) of the estimated acreage to be converted. An estimated 4,664 ac (1,887 ha) of forage land, and an estimated 777 ac (314 ha) of orchards (pecans) would also be converted. About 1,000 ac (405 ha) of converted land would be planted with permanent cover, providing wildlife habitat.

Phase 2 (from year 2011 to 2020)

During Phase 2 of the project, approximately 12,366 ac (5,004 ha) of irrigated agricultural lands would be converted to other uses. Approximately 8,244 ac (3,336 ha) would be in Texas, and 4,122 ac (1,668 ha) would be in New Mexico. Approximately 8,038 ac (3,253 ha) of the total are annual crops. An estimated 3,710 ac (1,501 ha) of forage crops would be converted, and approximately 618 ac (250 ha) of orchards would be converted during this phase of the project.

Phase 3 (from year 2021 to 2030)

During Phase 3 of the project, approximately 5,153 ac (2,085 ha) of New Mexico irrigated agricultural lands would be converted to other uses as a direct result of the project, and none would be converted in Texas. Of this total, approximately 3,349 ac (1,355 ha) are assumed to be in annual crops. Forage crops would account for approximately 1,545 ac (625 ha) of the total acreage converted during this phase of the project. Additionally, 258 ac (104 ha) of orchards would be converted.

During the project's 30-year term, a total of 33,066 ac (13,381 ha) of irrigated agricultural land would be converted to other uses as a direct result of the project:

- 14,344 ac (5,805 ha) of land use change in Texas; 6,100 ac (2,469 ha) in Phase 1, 8,244 ac (3,336 ha) in Phase 2, none in Phase 3
- 18,722 ac (7,577 ha) of land use change in New Mexico; 9,447 ac (3,835 ha) in Phase 1, 4,122 ac (1,668 ha) in Phase 2, and 5,153 ac (2,085 ha) in Phase 3

This represents approximately 21 percent of all irrigated agricultural lands within the project area. This conversion would result in a 34.6 percent reduction in the amount of good or average agricultural wildlife habitats.

Conversion of irrigated agricultural land for all of the action alternatives would be the same as described above, except for the River Conveyance with Year-Round Lower WTPs Alternative. For this alternative, an additional 11,666 ac (4,721 ha) would be converted during the project. Total converted land by phase for this alternative would be 21,380 ac (8,652 ha) in Phase 1, 18,199 ac (7,365 ha) in Phase 2, and 5,153 ac (2,085 ha) in Phase 3 (all in New Mexico only). Total project converted land area would be approximately 44,732 ac (18,102 ha).

The total permanent impacts from construction activities associated with the project features for each the Action Alternatives are:

- River Conveyance with Local WTPs (Preferred Alternative) - 1,142 ac (461 ha)
- River Conveyance with Year-Round Lower WTPs - 1,142 ac (461 ha)
- River Conveyance with Combined WTPs - 1,099 ac (444 ha)
- Aqueduct Conveyance with Local WTPs - 1,251 ac (505 ha)
- Aqueduct Conveyance with Combined WTPs - 1,208 ac (488 ha)

The above totals are land area permanently disturbed by construction for proposed project facilities including the WTP's, the El Paso Aqueduct, the New Mexico Aqueduct, and the Westside Regulating Reservoir.

The total temporary impacts from construction activities associated with the project features for each the Action Alternatives are:

- River Conveyance with Local WTPs (Preferred Alternative) - 292 ac (118 ha)
- River Conveyance with Year-Round Lower WTPs - 292 ac (118 ha)
- River Conveyance with Combined WTPs - 284 ac (115 ha)
- Aqueduct Conveyance with Local WTPs - 369 ac (149 ha)
- Aqueduct Conveyance with Combined WTPs - 361 ac (146 ha)

Temporary, short-term impacts to wildlife from noise, dust, and the presence of workers and machinery during project construction may occur during construction of diversion structures. Placement and removal of temporary cofferdams, construction forms, and backfill could

increase turbidity. Runoff from construction work sites, access routes, staging areas, and unprotected fills could degrade water quality in the river. Uncured concrete could increase alkalinity and conductivity, water quality factors to which cool water biota are sensitive. Accidental spills of fuels, lubricants, hydraulic fluids and other petrochemicals, although unlikely, would be harmful to aquatic life. Changes in flow through de-watering of the construction site could cause direct mortality to fish and aquatic invertebrates, and could disrupt fish spawning and cause mortality of incubating eggs downstream of construction sites.

Conversion of agricultural land to M&I use with the Preferred Alternative would increase in the project area. Development would be concentrated between El Paso and Las Cruces and southeast of El Paso. Demand for surface water would increase. Expected future trends for aquatic and terrestrial resources include the following:

- Urbanization in New Mexico would convert about 18,722 ac (7,577 ha) of irrigated agricultural lands.
- Urbanization in Texas would convert irrigated agricultural lands at a rate of about 717 ac (290 ha) per year for a total of 14,344 ac (5,805 ha) by the end of Phase 2.
- Flows in the La Mesa, East, and Montoya Drains are expected to decrease by about 10 percent. Flows in the Del Rio Drain are expected to increase by about 17 percent on average.
- Average monthly releases from Caballo Dam in the secondary irrigation season are expected to increase by approximately 24 percent above the No Action Alternative (about 91 percent above baseline) to about 199 to 210 cfs (5.8 to 5.9 cms) for all phases.
- Higher secondary irrigation releases from Caballo Dam would decrease exposed bottom area habitat, particularly in upstream reaches.

To meet the WTP demands associated with the Preferred Alternative, water would need to be released from Caballo Dam during the secondary irrigation season. One potential benefit of the Preferred Alternative for the Rio Grande fishery and other aquatic-dependent species lies in its contribution to a more reliable year-round flow regime. A more reliable flow regime would be necessary before effective enhancements to the riverine ecosystem could be considered. Average monthly releases from Caballo Dam during the secondary irrigation season with the Preferred Alternative would increase above the No Action Alternative from 167 to 210 cfs (4.7 to 5.9 cms) in Phase 1, 164 to 199 cfs (4.6 to 5.8 cms) in Phase 2, to 161 to 204 cfs (4.7 to 5.8 cms) in Phase 3. Average flows during the primary irrigation season with the Preferred Alternative would only be about three percent (41 cfs, 1.2 cms) lower than the No Action Alternative (by Phase 3).

In a typical year (50 percent exceedance) stream flows downstream of Percha Dam (1 mi; 1.6 km below Caballo Reservoir) would increase from about 20 cfs (0.6 cms) to about 75 cfs (2.1

cms). This increase of 55 cfs (1.6 cms) would continue approximately 70 mi (113 km) downstream, with additional accretion flow, until a portion of the flow (approximately 15 cfs, 0.4 cms) is diverted to the Las Cruces WTP. The residual augmentation would provide river flows of nearly 100 cfs (2.8 cms) in the 18-mi (29-km) reach between Mesilla Dam and the diversion to the Upper Valley WTP. Because this is a major component of the Preferred Alternative, river flows in the 10 mi (16 km) between the WTP diversion and the Montoya Drain discharge would decrease from 99 cfs (2.8 cms) (No Action Alternative) to 27 cfs (0.8 cms). Flows would then increase to more than 100 cfs (2.8 cms) down to American Dam as a result of the input from Montoya Drain.

Winter flow increases in more than 90 mi (145 km) of river would provide little benefit to the fishery. While the flows would likely increase winter habitat, particularly for larger fish, the fishery would still be limited by the altered stream channel and floodway, and high primary irrigation season flows. Thus, increased winter flows alone would not likely improve the fishery.

The higher winter releases with the Preferred Alternative would increase the wetted streambed perimeter in most river reaches. Aquatic productivity is generally related to the amount of streambed area that is wetted. Shallow areas, especially riffles, are the primary production areas for macroinvertebrates, which constitute much of the food base for fish and many shorebirds. Considerable gains in wetted perimeter would be realized with any flow gains below 400 cfs (11.3 cms). These gains would be most pronounced in the Percha-to-Leasburg reach where winter (December) flows would increase average wetted perimeter by about 50 percent and where there are a number of riffles with gravel substrate. The winter increases in wetted perimeter would continue downstream for 90 mi (145 km) (from Percha Diversion Dam) until the water reaches the proposed diversion to the Upper Valley WTP. From this point to American Diversion Dam (18 mi; 29 km), river flows and the corresponding wetted perimeter would decrease compared to the No Action Alternative.

Increased winter flows would inundate river bottom habitat and would decrease shallow (less than 6 in [15 cm]) low velocity habitat. These habitats are important to shorebirds (killdeer, least sandpiper, etc.), wintering migratory birds, hibernating herptiles (softshell turtles), and juvenile fish species, particularly in areas upstream of Leasburg Diversion.

During the primary irrigation season, stream flows in the project area would decrease on average by about 41 cfs with the Preferred Alternative, primarily a result of agricultural land retirement to meet winter M&I needs. Flows downstream of Percha Dam in June, for example, would decrease from 1,451 cfs to 1,382 cfs (41 to 39 cms), or about 5 percent. The reduction in flow would be more pronounced (17 percent) downstream of the diversion to the Upper Valley WTP.

The high flows typical of the primary irrigation season (greater than 1,000 cfs [28 cms]) provide little habitat for the fish community. In particular, suitable spawning habitat is severely limited at these flows, which coincide with the spawning season for most fish species. The lack of spawning and rearing habitat at the higher flows is attributed to high water velocities in the narrowed channel. The slight flow decreases in the river during the primary irrigation season with the Preferred Alternative would have no effect on the fish community.

During average water years, the predicted water surface elevations of Elephant Butte Reservoir with the Preferred Alternative March through June would be 2 ft (0.6 m) higher than the No Action Alternative. Water levels would drop between March and April by 2 ft (0.6 m) with the Preferred Alternative, as they would with the No Action Alternative, but then would increase through the rest of the spawning season. The drop in water level between March and April could adversely affect early spawning species such as walleye and smallmouth bass, but not later spawners such as largemouth bass, white bass, white crappie, and catfish.

During dry years, water levels would be about 60 ft (18 m) lower than in average years, thus providing less spawning habitat (water less than 4 ft [1.2 m] deep). However, compared to the No Action Alternative, the Preferred Alternative would result in water levels 5 to 9 ft (1.5 to 2.7 m) higher. This would provide access to about 10 percent more spawning habitat. Water levels would tend to drop during the spawning season during dry years, but slower than with the No Action Alternative. Thus, both the increased water levels and the reduced rate of decline during the spawning season with the Preferred Alternative could enhance spawning success during these years.

With the Preferred Alternative, the reservoir would essentially be at maximum water level during the spring in wet years. This would be the same as the No Action Alternative. Availability and stability of spring spawning habitat would be highest under these conditions (CH2M HILL and Geo-Marine, Inc. 2000).

During the spring, Caballo Reservoir is usually maintained between elevations 4,143 and 4,174 ft (1,263 and 1,272 m). Within these elevations, the available area of spawning habitat (water less than 4 ft [1.2 m] deep) is relatively constant with the exception of a substantial decline between elevations 4,160 ft (1,268 m) and 4,170 ft (1,271 m). In average and wetter-than-average years, the reservoir level is maintained at a stable elevation within 1 ft (0.3 m) during the spring months. During dry years it tends to drop by about 5 ft (1.5 m) between April and June.

Compared to the No Action Alternative, the Preferred Alternative would not result in any change in water surface elevation during the spring months. Therefore, no effects on the reservoir's fishery would be expected with the Preferred Alternative.

Flows in the La Mesa, East, and Montoya Drains are expected to decrease by about 10 percent with the Preferred Alternative. This decrease would be evenly distributed among all months and would not likely effect the existing marginal fishery. Flows in the Del Rio Drain are expected to increase by about 17 percent on average. This change in flow could provide some localized benefit to the Del Rio drain fishery.

Lining the first 2.1 mi (3.4 km) of the Riverside Canal would decrease recharge to the shallow aquifer as well as the Rio Grande downstream of the broken Riverside Diversion. This would impact the Rio Grande where subsurface recharge maintains the only riparian habitat along the river in the entire area.

Threatened and Endangered Species

These issues will be addressed during the section 7 process for this project.

DISCUSSION

The Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667e) directs the Federal action agency to consult with the Service for purposes of "preventing a net loss of and damage to wildlife resources." It further directs the action agency to give wildlife conservation measures equal consideration to features of water resource development. Consideration is to be given to all wildlife, not simply those that are legally protected under the Endangered Species Act or those with high economic and recreational value. Further, the recommendations of the Service which follow are to be given full consideration by the action agency. All aspects of the Project should be designed and constructed to avoid and minimize impacts to wildlife resources.

Construction projects that result in adverse impacts to fish and wildlife require the development of mitigation plans. These plans consider the value of fish and wildlife habitat affected. The Service has established a mitigation policy used as guidance in recommending mitigation (Service 1981). The policy states that the degree of mitigation should correspond to the value and scarcity of the fish and wildlife habitat at risk. Four resource categories in decreasing order of importance are identified:

Resource Category No. 1 Habitats of high value for the species being evaluated that are unique and irreplaceable on a national basis or in the ecoregion section. No loss of existing habitat value should occur.

Resource Category No. 2 Habitats of high value that are relatively scarce or becoming scarce on a national basis or in the ecoregion section. No net loss of in-kind habitat value should occur.

Resource Category No. 3 Habitats of high to medium value that are relatively abundant on a national basis. No net loss of habitat value should occur and loss of in-kind habitat should be minimized.

Resource Category No. 4 Habitats of medium to low value. Loss of habitat value should be minimized.

The habitats in the immediate project area are classified as follows: Resource Category No. 2 - riparian vegetation (includes trees and shrubs such as willows), Resource Category No. 3 - aquatic habitat, and Resource Category No. 4 - grassland and agricultural fields.

Riparian habitats are classified in category 2 because they are scarce and disappearing at an astounding rate. About 90 percent of the historic wetland and riparian habitat in the southwest has been eliminated (Johnson and Jones 1977). Hink and Ohmart (1984) found a wetland decrease of 87 percent along the Rio Grande from 1918 to 1982. The mitigation goal for riparian areas (trees and shrubs) in the project area is no net loss in wildlife value as a result of the proposed project.

Aquatic habitats are classified in category 3 because they are relatively abundant in the southwest, yet provide high to medium wildlife value. The mitigation goal for aquatic habitat (e.g., islands, shallow water) is to have no net loss of habitat value and to minimize loss of in-kind habitat.

Grassland and agricultural fields are considered category 4 because they are abundant in the southwest and are of relatively low value to wildlife. The mitigation goal for this category is to minimize impacts when possible.

Once mitigation measures have been implemented, monitoring programs must be established to evaluate their effectiveness. Where monitoring reveals that mitigation is ineffective or deficient, measures must be adjusted so that full compensation is attained. Mitigation of impacts should not be considered complete until those measures have been evaluated to ensure full compensation of resources impacted by the Project. Mitigation must be implemented concurrent with, or in advance of, impacts to the resources.

In comparing the impacts of each alternative, the Service has not considered the fish and wildlife enhancements that were discussed in the DEIS (2000) because there is no stated commitment to implement them. The Service has ranked the Project alternatives in terms of their potential impacts on aquatic and terrestrial resources from least to most:

- River Conveyance with Combined WTPs
- River Conveyance with Local WTPs (Preferred Alternative)
- Aqueduct Conveyance with Combined WTPs
- River Conveyance with Year-Round Lower WTPs
- Aqueduct Conveyance with Local WTPs

In addition to ranking the alternatives, the Service has rated the alternatives in terms of their potential to enhance aquatic and terrestrial communities. The River Conveyance with Year-Round Lower WTPs Alternative has the most long-term potential based upon the expected flow regime, particularly in Texas, and agricultural land use conversion. However, without substantial floodplain rehabilitation, this alternative could have major impacts to aquatic resources, particularly during winter. The Preferred and the River Conveyance with Combined WTPs Alternatives are nearly identical in terms of stream flows, temporary and permanent project impacts, and their potential for long-term rehabilitation. The Aqueduct Conveyance with Combined WTPs and the Aqueduct Conveyance with Local WTPs Alternatives have the most permanent impacts from construction of facilities, and remove more water from the river further upstream, and thus have the least potential for long-term rehabilitation.

Impacts from implementation with any or all of the Action Alternatives include losses in exposed river bottom areas (maximum of 426 to 1,204 ac [172 to 487 ha]) and shallow water

habitat (maximum of 53 to 215 ac [21 to 87 ha]), riparian habitat (minimum of 4 ac [1.6 ha]), agricultural land use conversion (33,066 to 44,732 ac [13,381 to 18,102 ha]), temporary and permanent impacts with construction of the WTPs (temporary 284 to 369 ac [115 to 149 ha]; permanent 1,099 to 1,251 ac [444 to 505 ha]), and potential losses in irrigation drain quantity and quality.

The mitigation proposals incorporate many of the recommendations from the environmental enhancements described in the DEIS (2000). The enhancements provide an opportunity to create wetlands within the Rio Grande corridor, restore fisheries habitat, and enhance or create new native riparian communities.

In the project area, management activities are unlikely to provide the overbank flows necessary for vegetation regeneration of floodplain-associated species such as willows and cottonwoods. By widening the river channel, developing flood terraces, creating flow-through side channels, wetlands, and other similar habitats, fish spawning habitat can be created, island habitat can be recovered, and other aquatic habitats can be re-established. Flows through the side channels even for short periods of time, such as several months of the year (spring and summer), could be extremely beneficial for the environment and could establish regeneration of desirable native vegetation.

The development of terraces and, where possible, meanders, would increase habitat complexity and provide low-velocity habitats during the primary irrigation season, thus providing a more natural channel pattern and profile. These areas would reduce water velocities, decrease flow depth, and increase width-to-depth ratios. Reaches where the river channel can be widened, preferably in reaches with higher winter flows (e.g., upstream of Leasburg Dam), should be identified. Mitigation to offset adverse effects should create 3 mi (4.8 km) of wider river channel habitat and would be based on the "habitat bead" concept (Rasmussen 1995). This concept attempts to restore a semblance of a river's natural features by including several habitat features in localized areas. Mitigation should be implemented incrementally: 1 to 2 reaches (each 0.5 mi; 0.8 km) every other year until the 3 mi (4.8 km) are completed. These areas would be monitored to ensure their effectiveness and to determine any necessary design changes for the development of future reaches. These areas should be fenced where grazing is allowed, should not be mowed (allow establishment of native riparian habitat), and be managed to control non-native vegetation. Because there would be additional winter habitat (e.g., exposed river bottom area) losses in both of the Aqueduct Alternatives (34 percent) and the River Conveyance with Year-Round Lower WTPs Alternative (183 percent), more river rehabilitation would be required; 1 mi (1.6 km) and 2 mi (3.2 km), respectively.

Within each of these created habitats, inlets to newly created or existing channels would be notched to allow normal and high flows to pass through while preventing the river's bedload sediments from entering and filling up the side channels. The notched structures would also

ensure that the small channels would not capture too much of the main channel's flow and water supply. These off-channel habitats, connected to the river, could provide suitable spawning depths and velocities and quiet rearing areas during the primary irrigation season. Similar habitats could also be developed by notching into and upstream of the confluence to irrigation drains or laterals with the Rio Grande to create flowing side-channels as well as island habitat.

Removing rip-rap and lowering the tops of banks to widen the river top width would allow peak water flow to "spill" onto the floodplain to water areas. Providing more frequent off-channel inundation would create additional riverine habitat and promote riparian habitat development. Within these same areas, in-stream habitats and cover could be developed by placing boulders (e.g., vortex weirs, boulder piles) in the river channel to create low-velocity habitats. These could be designed by modifying mitigation structures developed in the Hatch area by the USIBWC. Mitigation to offset adverse project effects should remove 2 mi (3.2 km) of rip-rap. Mitigation should be implemented incrementally: 1 to 2 reaches (each 0.5 mi; 0.8 km) every other year until the 2 mi (4.8 km) are completed. These areas would be monitored to ensure their effectiveness and to determine any necessary design changes for the development of future reaches. Because of the additional winter habitat losses (described above) in both of the Aqueduct Alternatives and the River Conveyance with Year-Round Lower WTPs Alternative, more river rehabilitation would be required; 1 mi (1.6 km) and 2 mi (3.2 km), respectively.

The value of the area for fish and wildlife would be enhanced by the creation and maintenance of converted agricultural lands (preferably larger blocks with travel corridors) for wildlife species. This is particularly true for wildlife species that live in upland areas, removed from the floodplain, but require periodic visits to the river for water and food. Travel corridors are often vegetated arroyos and drainages that provide cover during wildlife movements to and from the floodplain. Converted agricultural land could be planted with desired native species to provide wildlife habitat. Converted areas near or adjacent to wildlife corridors would assist re-colonizing, particularly by herptile communities and species that require large home ranges. Land permanently disturbed by construction of facilities should be similarly mitigated. Because there is a range of low to moderate wildlife habitat value for agricultural lands in the project area, and a large quantity of agricultural land being converted or permanently disturbed by the project, these areas should be mitigated and planted with native vegetation to provide permanent cover for wildlife. The proposal to develop 1,000 ac (405 ha) of wildlife habitat, to mitigate for the loss of wildlife habitat in agricultural land (33,066 ac; 13,381 ha) that would be retired, is adequate mitigation because: the majority of agricultural land converted is low value wildlife habitat; over 80 percent is below average value as determined by the habitat evaluation; the species diversity in agricultural land is low; the expected wildlife value of the new area would be much higher than the agricultural land; and much of the agricultural land may be converted in the future without the project. These areas should be developed where wildlife corridors can be

established or maintained to ensure colonization and gene flow between populations. These areas should be fenced and managed to control invasion of non-native vegetation.

Lining the first 2.1 mi (3.4 km) of the Riverside Canal would decrease recharge to the shallow aquifer as well as the Rio Grande downstream of the broken Riverside Diversion. Mitigation should be provided by improving and expanding the wetland just downstream of the Jonathan Rogers WTP. Improvement should include planting with native vegetation such as cottonwoods and willows.

Significant losses of fish can occur by entrainment in diversion structures. The diversion structures at WTP sites should be designed to prevent or minimize entrainment of fish and ensure upstream movement. Proper orientation of the diversion head structure to stream flow, such as aligning the intakes parallel to flow, or use of fish exclusion screens, could minimize entrainment of fish into diversion structures. An added benefit would be a reduced need for maintenance of the structure, as woody debris would be less likely to accumulate at the intake. The diversions should be monitored to ensure continuous upstream fish passage in the future. Should monitoring of drain habitats reveal a loss in drain quantity or quality, mitigation should be provided, and include establishing wetland habitats or developing improvements in other drain habitats.

A watershed planning group, known as the Paso del Norte Watershed Council (Council), has been established by the Commission. The primary purpose of the Council will be to investigate, develop, and recommend options for watershed management and explore how water-related resources can best be balanced to benefit the interests of all watershed stakeholders, including the Rio Grande ecosystem. The Council will focus on the Paso del Norte watershed of the Rio Grande basin between Elephant Butte Reservoir in southern New Mexico and Fort Quitman, Hudspeth County, Texas. It will provide an open and inclusive forum for communication, collaboration and innovative thinking among binational stakeholders to achieve a healthy watershed in the Rio Grande sub-basin between Elephant Butte Dam and Fort Quitman. The Council will promote and coordinate restoration and enhancement activities, foster communication and collaboration to make best use of available resources, and work to ensure both ecosystem and economic sustainability in the region. The Council will satisfy a portion of the recommended mitigation.

To minimize temporary, short-term impacts during construction of the WTPs and associated features, the following measures should be implemented:

- Construction activities in the Rio Grande should be conducted during low flow (secondary irrigation season) or low precipitation periods.
- Construction work areas should be de-watered with cofferdams constructed of materials that cannot be brought into suspension by flowing water.

- Runoff from construction sites should be contained and poured concrete should be contained in sealed forms and/or behind cofferdams to prevent discharge into the river.
- Place no surplus concrete within the 100-year floodplain. Contain and treat or remove wastewater from concrete batching, vehicle washdown, and aggregate processing.
- Place only clean, coarse, and erosion-resistant fills in the water and employ silt curtains, settling basins, or other suitable means to control turbidity.
- Store and dispense all fuels, lubricants, hydraulic fluids, and other petrochemicals above the 100-year floodplain.
- Inspect all equipment daily to ensure there are no leaks or discharges of lubricants, hydraulic fluids, or fuels.
- Contain and remove any petrochemical spills, including contaminated soil, and dispose of these materials at an approved upland disposal site.
- All temporarily disturbed construction areas should be revegetated with native vegetation following construction activities.

The proposed construction periods may overlap with the bald eagle winter use season of their habitat in the project area, particularly in Doña Ana County. Since bald eagles are sensitive to human disturbance, construction activities within the project area may cause them to move and concentrate at other sites or use less than optimal habitat. Impacts can be minimized by delaying the beginning of construction activities in the morning if a bald eagle is present in or near the construction area.

If a bald eagle is present within 0.5 mi (0.8 km) upstream or downstream of the active project site in the morning before project activity starts, or following breaks in project activity, the contractor should be required to suspend all activity until the bird leaves of its own volition, or in consultation with the Service, determines that the potential for harassment is minimal. However, if a bald eagle arrives during construction activities or if a bald eagle is beyond that distance, construction need not be interrupted. If bald eagles are found consistently in the immediate project area during the construction period, the contractor should contact the Service to determine whether formal consultation under the Endangered Species Act is necessary.

In summarizing the fisheries analysis regarding Rio Grande stream flows for both the No Action and Preferred Alternatives, it is clear that the flow regime alone is not the overriding factor contributing to the marginal fishery. As the habitat modeling and impact analysis demonstrate, crucial habitat needs for nearly all of the existing and potentially occurring fish species, including the native species, are only marginally met under any flow regime. In particular, the quiet and slow waters of moderate depth, which most species require for spawning and juvenile rearing, are essentially non-existent.

In summary, because of the loss of exposed river bottom area, shallow water habitat, irrigated agricultural land, wetland habitat, and permanent and temporary losses from the construction associated with the WTP, the Service recommends the following general measures to mitigate these impacts: rehabilitate 3 mi (4.8 km) of Rio Grande floodplain; rip-rap removal, bank lowering, and construction of instream habitat structures in the Rio Grande for 2 mi (3.2 km); establishment of 1,000 ac (405 ha) of wildlife habitat on retired agricultural land; improve and expand the wetland near the Jonathan Rogers WTP; maintain the Watershed Council; implement measures to avoid impacting water quality; revegetate disturbed soils; avoid impacting bald eagles; and monitor mitigation measures, drain impacts and enhancements.

One benefit of the Preferred Alternative for the Rio Grande fisheries and other aquatic-dependent species is the contribution to a more year-round flow regime that would be necessary before effective enhancements to the riverine ecosystem could be considered. The instream flow habitat analysis identifies critical fish habitat needs that should help focus the design of enhancement and mitigation measures consistent with the project goal (all alternatives) to improve the Rio Grande ecosystem to the extent practicable. Specifically, off-channel habitat within the levees and habitats connected to the river would need to be created to provide some quiet, protected water for successful spawning and early rearing. These enhancements would provide significant benefits to wildlife as well. Planning and conceptual designs for the ecosystem enhancement component of the proposed project are currently underway.

If enhancements are implemented, secondary irrigation flows for the proposed regional project could provide an opportunity to positively affect the Rio Grande ecosystem. The project, with enhancements, could provide an operational channel and floodplain, with reduced water velocities, decreased flow depth, and increased width-to-depth ratios. This would improve aquatic habitat conditions for wintering fish and water-dependent birds. Development of backwater and wetland habitat could be slightly increased, improving conditions for a variety of fish and wildlife. In addition, portions of the riparian area could be restored by removing non-native vegetation and planting native vegetation, improving wildlife habitat conditions, especially for birds.

RECOMMENDATIONS

Based upon the evaluation of fish and wildlife impacts of the proposed action, and the existing ecosystem condition of the Rio Grande from Elephant Butte Reservoir to El Paso, the following recommendations are provided by the Service.

To mitigate for expected impacts of all the proposed alternatives:

1. Widen the Rio Grande channel, and levee (where needed), for 3 mi (4.8 km) in approximately 0.5 mi (0.8 km) reaches to create shallow water habitat, exposed river bottom area, low velocity habitat, riparian vegetation habitat, and small side channels with flow (during the primary irrigation season). Include the development of terraces and, where possible, meanders. This proposal could be accomplished in one to two reaches every other year with monitoring to determine future improvements.
2. Add 1.0 mi (1.6 km) to the mitigation described in recommendation 1 for both of the Aqueduct Alternatives, and 2.0 mi (3.2 km) for the River Conveyance with Year-Round Lower WTPs Alternative.
3. Remove 2 mi (3.2 km) of rip-rap and lower the tops of banks to widen the river top width and develop in-stream habitats (low-velocity) and cover by placing boulders (e.g., vortex weirs, boulder piles) in the river channel in 0.5 mi (0.8 km) reaches.
4. Add 1.0 mi (1.6 km) to the mitigation described in recommendation 3 for both of the Aqueduct Alternatives, and 2.0 mi (3.2 km) for the River Conveyance with Year-Round Lower WTPs Alternative.
5. Plant 1,000 ac (405 ha) of retired agricultural lands with permanent cover using native vegetation to provide wildlife habitat.
6. Improve and expand the wetland just downstream of the Jonathan Rogers WTP.
7. Monitor all new diversion structures for two years to ensure upstream fish passage is not blocked, reduced, or otherwise limited, and modified if necessary to achieve success.
8. Install fish screens or other fish exclusion devices on all diversion structures. If entrainment occurs, the problem should be remedied immediately.
9. Monitor mitigation measures, drain impacts, and fish and wildlife enhancement measures for two years following completion of each project (monitor drains five years following completion of each Phase) to ensure success and replace unsuccessful projects.

10. Develop a coordinated program, via the Paso del Norte Watershed Council, to select and recommend fish and wildlife enhancements for implementation under the selected alternative.

11. Ensure water quality by implementing the following measures:

- a. Construction activities in the Rio Grande should be conducted during low flow (secondary irrigation season) or low precipitation periods.
- b. Construction work areas should be de-watered with coffer dams constructed of materials that cannot be brought into suspension by flowing water. Contain runoff from construction sites and contain any poured concrete in sealed forms and/or behind cofferdams to prevent discharge into the river. Place no surplus concrete within the 100-year floodplain. Contain and treat or remove wastewater from concrete batching, vehicle washdown, and aggregate processing.
- c. Place only clean, coarse, and erosion-resistant fills in the water and employ silt curtains, settling basins, or other suitable means to control turbidity.
- d. Store and dispense all fuels, lubricants, hydraulic fluids, and other petrochemicals above the 100-year floodplain. Inspect all equipment daily to ensure there are no leaks or discharges of lubricants, hydraulic fluids, or fuels. Contain and remove any petrochemical spills, including contaminated soil, and dispose of these materials at an approved upland disposal site.

12. Revegetate temporarily disturbed construction areas with native vegetation following construction activities.

13. Avoid impacting bald eagles during project activities. If bald eagles are found in the immediate project area during the construction period, the contractor should contact the Service to determine whether formal consultation under the Endangered Species Act is required.

To improve overall fish and wildlife habitat in the project area:

14. Manage riparian habitat for Southwestern willow flycatcher. Management could include conservation easements, conservation agreements, land purchase, and cowbird trapping.

15. Commit the two percent of the project budget and implement the fish and wildlife enhancements as proposed in the DEIS for all of the Action Alternatives.

16. A monitoring plan should be developed and coordinated with others doing studies in the Rio Grande to provide consistency in data collections. The monitoring plan should include vegetative planting success, and river channel and backwater cross-section information. Inventories of fish, wildlife, and vegetation should also occur.

As identified in the Final Environmental Impact Statement (2000) for this project, the sponsoring utilities will commit two million dollars to study and implement mitigation recommendation items 1, 2, 3, and 4. The Service and the Watershed Council will provide input into the development of these recommendations and the Service will determine the appropriateness of the mitigation to offset the impacts to fish and wildlife resources as identified in this report. These funds will be separate and in addition to the two percent of construction costs for recommendation items 5 through 16 and for other enhancements identified in the DEIS (2000).

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Appendix A. Common and Scientific Names of Fish Species in the Rio Grande Project Area Downstream of Caballo Reservoir in Doña Ana, Sierra, and El Paso Counties.

Common Name	Scientific Name
longnose gar ^a	<i>Lepisosteus osseus</i>
gizzard shad	<i>Dorosoma cepedianum</i>
threadfin shad	<i>Dorosoma petenense</i>
red shiner	<i>Cyprinella lutrensis</i>
common carp	<i>Cyprinus carpio</i>
golden shiner	<i>Notemigonus crysoleucas</i>
fathead minnow	<i>Pimephales promelas</i>
bullhead minnow	<i>Pimephales vigilax</i>
longnose dace	<i>Rhinichthys cataractae</i>
river carpsucker	<i>Carpionodes carpio</i>
smallmouth buffalo ^b	<i>Ictiobus bubalus</i>
gray redhorse ^b	<i>Moxostoma congestum</i>
black bullhead	<i>Ameiurus melas</i>
flathead catfish	<i>Pylodictis olivaris</i>
channel catfish	<i>Ictalurus punctatus</i>
green sunfish	<i>Lepomis cyanellus</i>
longear sunfish	<i>Lepomis megalotis</i>
bluegill	<i>Lepomis macrochirus</i>
largemouth bass	<i>Micropterus salmoides</i>
spotted bass	<i>Micropterus punctulatus</i>
white crappie	<i>Pomoxis annularis</i>
yellow perch	<i>Perca flavescens</i>
white bass	<i>Morone chrysops</i>
walleye	<i>Stizostedion vitreum</i>
western mosquitofish	<i>Gambusia affinis</i>

^a Possible sighting near Sunland Park, New Mexico, north of El Paso, 10 June 1999

^b None collected during fish surveys, September 1999 through July 2000

Appendix B. Common and Scientific Names of Vegetation Discussed In the Rio Grande Project Area Downstream of Caballo Reservoir in Doña Ana, Sierra, and El Paso Counties.

Common Name	Scientific Name
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boxelder	<i>Acer</i> spp.
juniper	<i>Juniperus</i> spp.
mesquite	<i>Prosopis</i> spp.
Rio Grande cottonwood	<i>Populus deltoides</i>
Russian olive	<i>Elaeagnus augustifolia</i>
salt cedar	<i>Tamarix</i> spp.
banana yucca	<i>Yucca baccata</i>
buttonbush	<i>Cephalanthus</i> spp.
coyote willow	<i>Salix exigua</i>
creosotebush	<i>Larrea tridentata</i>
Goodding willow	<i>Salix gooddingii</i>
ocotillo	<i>Fouquieria splendens</i>
peachleaf willow	<i>Salix amygdaloides</i>
soaptree	<i>Yucca elata</i>
sotol	<i>Dasylirion wheeleri</i>
tarbush	<i>Flourensia cernua</i>
broom snakeweed	<i>Amphiachrysis dracunuloides</i>
desert holly	<i>Perezia nana</i>
desert marigold	<i>Baileya multiradiata</i>
dogweed	<i>Dyssodia</i> spp.
red globemallow	<i>Spharalcea incana</i>
alkali sacaton	<i>Sporobolus airoides</i>
Bermuda grass	<i>Cynodon dactylon</i>
black grama	<i>Bouteloua eriopoda</i>
blue grama	<i>Bouteloua gracilis</i>
bush muhly	<i>Muhlenbergia porteri</i>
curlyleaf muhly	<i>Muhlenbergia setifolia</i>
fluff grass	<i>Erioneuron pulchellum</i>
giant sacaton	<i>Sporobolus wrightii</i>
gypgrass	<i>Sporobolus nealleyi</i>
mesa dropseed	<i>Sporobolus flexuosus</i>
saltgrass	<i>Distichlis</i> spp.
sideoats grama	<i>Bouteloua curtipendula</i>
six-weeks grama	<i>Bouteloua barbata</i>

Appendix B. Continued.

Common Name	Scientific Name
spike dropseed tobosa	<i>Sporobolus contractus</i> <i>Hilaria mutica</i>

Appendix C. Common and Scientific Names of Mammals Discussed In the Rio Grande Project Area Downstream of Caballo Reservoir in Doña Ana, Sierra, and El Paso Counties.

Common Name	Scientific Name
coyote	<i>Canis latrans</i>
raccoon	<i>Procyon lotor</i>
striped skunk	<i>Mephitis mephitis</i>
mule deer	<i>Odocoileus hemionus</i>
beaver	<i>Castor canadensis</i>
muskrat	<i>Ondatra zibethicus</i>
bobcat	<i>Lynx rufus</i>
gray fox	<i>Urocyon cinereoargenteus</i>
desert cottontail	<i>Sylvilagus audubonii</i>
black-tailed jackrabbit	<i>Lepus californicus</i>
western pipistrelle bat	<i>Pipistrelle hesperus</i>
rock squirrel	<i>Spermophilus variegatus</i>
spotted ground squirrel	<i>Spermophilus mexicanus</i>
Botta's pocket gopher	<i>Thomomys bottae</i>

Appendix D. Common and Scientific Names of Birds Discussed In the Rio Grande Project Area Downstream of Caballo Reservoir in Dofia Ana, Sierra, and El Paso Counties.

Common Name	Scientific Name
green-winged teal	<i>Anas crecca</i>
mallard	<i>Anas platyrhynchos</i>
gadwall	<i>Anas strepera</i>
northern shoveler	<i>Anas clypeata</i>
common merganser	<i>Mergus merganser</i>
northern pintail	<i>Anas acuta</i>
redhead	<i>Aythya valisineria</i>
lesser scaup	<i>Aythya affinis</i>
common goldeneye	<i>Bucephala clangula</i>
killdeer	<i>Charadrius vociferus</i>
black-necked stilt	<i>Himantopus mexicanus</i>
greater yellowlegs	<i>Tringa melanoleuca</i>
lesser yellowlegs	<i>Tringa flavipes</i>
spotted sandpiper	<i>Actitis macularia</i>
least sandpiper	<i>Calidris minutilla</i>
long-billed dowitcher	<i>Limnodromus scolopaceus</i>
common snipe	<i>Gallinago gallinago</i>
American kestrel	<i>Falco sparverius</i>
rock dove	<i>Columba livia</i>
mourning dove	<i>Zenaida macroura</i>
northern mockingbird	<i>Mimus polyglottos</i>
western meadowlark	<i>Sturnella neglecta</i>
red-winged blackbird	<i>Agelaius phoeniceus</i>
horned lark	<i>Eremophila alpestris</i>
American pipit	<i>Anthus rubescens</i>
red-tailed hawk	<i>Buteo jamaicensis</i>
verdin	<i>Auriparus flaviceps</i>
cactus wren	<i>Campylorhynchus brunneicapillus</i>
black-throated sparrow	<i>Amphispiza bilineata</i>
ash-throated flycatcher	<i>Myiarchus cinerascens</i>
Scott's oriole	<i>Icterus parisorum</i>
greater roadrunner	<i>Geococcyx californianus</i>

Appendix D. Continued.

Common Name	Scientific Name
black-chinned hummingbird	<i>Archilochus alexandri</i>
ladder-backed woodpecker	<i>Picoides scalaris</i>
pyrrhuloxia	<i>Cardinalis sinuatus</i>
Gambel's quail	<i>Callipepla gambelii</i>
barn swallow	<i>Hirundo rustica</i>
house finch	<i>Carpodacus mexicanus</i>
great blue heron	<i>Ardea herodias</i>
great-tailed grackle	<i>Quiscalus mexicanus</i>
turkey vulture	<i>Cathartes aura</i>
house sparrow	<i>Passer domesticus</i>
raven	<i>Corvus corax</i>
chipping sparrow	<i>Spizella passerina</i>
bald eagle	<i>Haliaeetus leucocephalus</i>
southwestern willow flycatcher	<i>Empidonax traillii extimus</i>

Appendix E. Common and Scientific Names of Amphibians and Reptiles Discussed In the Rio Grande Project Area Downstream of Caballo Reservoir in Doña Ana, Sierra, and El Paso Counties.

Common Name	Scientific Name
Amphibians	
bullfrog	<i>Rana catesbiana</i>
Woodhouse's toad	<i>Bufo woodhouseii</i>
leopard frog	<i>Rana pipiens</i>
tiger salamander	<i>Ambystonum tigrinum</i>
Great Plains toad	<i>Bufo cognatus</i>
western green toad	<i>Bufo debilis insidiator</i>
red-spotted toad	<i>Bufo punctatus</i>
Couch's spadefoot	<i>Scaphiopus couchii</i>
plains spadefoot	<i>Spea bombifrons</i>
Reptiles	
spiny softshell turtle	<i>Trionyx spiniferus</i>
whiptail (six species)	<i>Cnemidophorus</i> spp.
desert box turtle	<i>Terrepene ornata luteola</i>
western blind snake	<i>Leptotyphlops humilis</i>
ground snake	<i>Sonora semiannulata</i>
western diamondback rattlesnake	<i>Crotalus atrox</i>
Sonoran gopher	<i>Pituophus catenifer</i>